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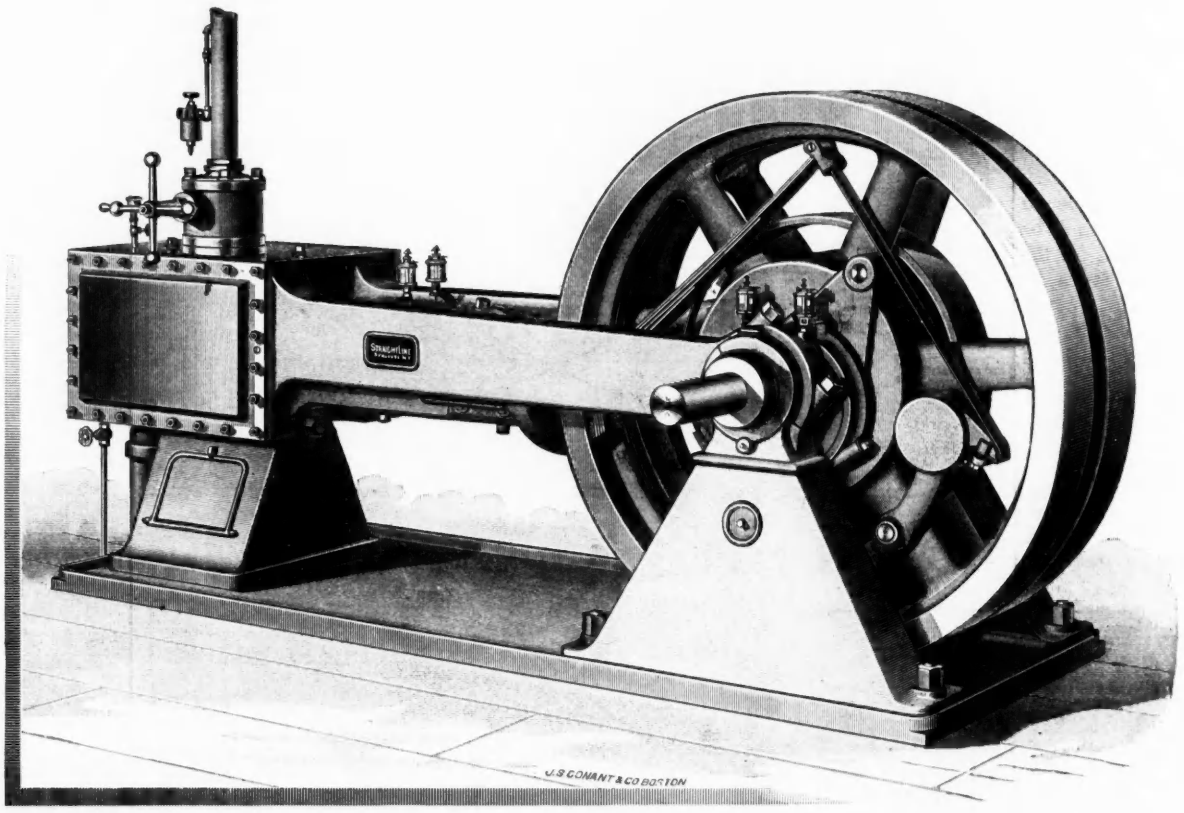
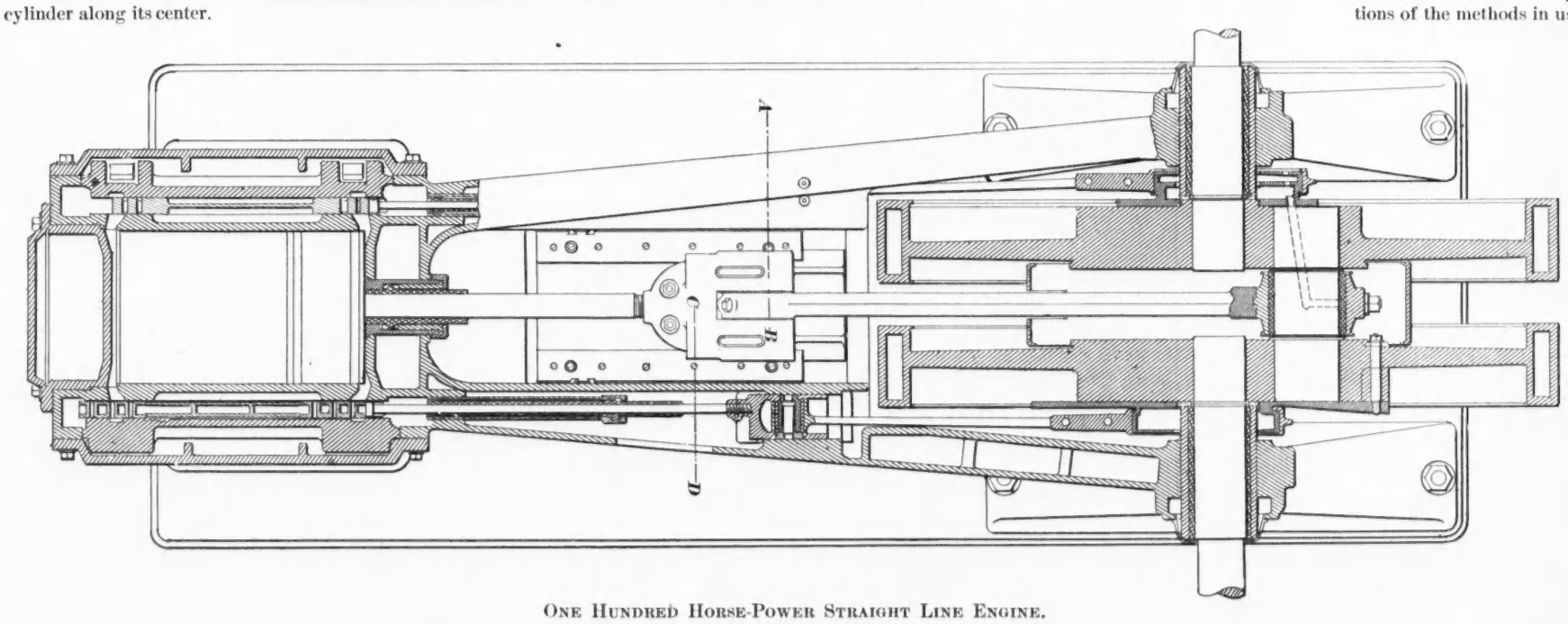
One Hundred Horse-Power Straight Line Engine.

We illustrate, on this page and on page 2, a recently designed one hundred horse-power engine, built by the Straight Line Engine Co., Syracuse, N. Y., which differs from all engines heretofore built by that company in that it has an independent exhaust valve; it also differs in the construction of the governor and its connection with the valye.

The general design of the engine is the same as all engines built by this company, but it will be noticed that the cylinder is square outside. The steam valve being on one side, and the exhaust valve on the other, explains the reason for such a shape, and the ports being nearly straight in from the steam chest, requires the chests to be as long as the cylinder.

The horizontal section gives a general idea of the arrangement. The steam and exhaust valves admitting and exhausting steam over their ends, permits of the arrangement that shuts off the live steam and also the exhaust steam from the cylinder along its center.





ONE HUNDRED HORSE-POWER STRAIGHT LINE ENGINE.

A fixed eccentric controls the exhaust valve, and necessarily the exhaust and compression, and a shifting eccentric operated by a governor—acting on the same principle as the governors controlling the valve in this company's single valve engines—operates the steam valve, and so controls the admission and cut-off.

A feature introduced at this point makes this engine differ from all others, so far as we know. While the lead of engines of this class (that is, engines having one or more valves for live steam, and one or more for exhaust,) is made as nearly constant as possible, in this engine the lead is variable as well as the cut-off. That is to say, when taking steam three-quarter stroke, which it does while yet under the control of the governor, there is a prominent positive lead, and when cutting off short, either no lead or negative lead. The object of this may be understood by reference to the two indicator diagrams shown on page 2. It is a generally understood fact that compression does not begin to bring the piston to rest until the pressure on the compression side exceeds the pressure on the expansion side of the piston, which in Fig. 1 is at *a*. From this it will be seen that the piston will have to travel from the point *a* to the end of the stroke, for a distance equal to that from *b* to *c*, and against a pressure represented by the shaded section, which pressure acting through that length of time is sufficient to bring the reciprocating parts to rest. As shown in Fig. 2, the distance from *d* to *e* is scarcely more than one-third as much as the corresponding distance in Fig. 1, and the force represented by the shaded lines being so much less, and lacking so much of being enough to bring the reciprocating parts to rest, a prominent lead is given, to prevent thumping.

The engraving shows the governor which controls the shifting eccentric, and the new feature is the introduction of a metal strap in the place of links, the object being to prevent friction and wear of link pivots, and the wear of the governor pivot. The metal strap is simply a band-saw blade, minus the teeth.

The connection between eccentrics and valves is quite direct, and the constructive arrangement, though appearing to make the parts difficult of access, really does the reverse.

The general dimensions are 14″ x 16″ cylinder, 62″ fly-wheels, weighing about 2¼ tons; and entire weight of engine, about 6 tons; revolutions per minute, 220.

Oil as Fuel for Steam Boilers.

BY PROF. A. T. WOODS.

Within the last two years a large number of experimental applications of oil as fuel under steam boilers have been made, and in a number of cases the superior economy of oil, as compared with coal, appears to be regarded as a settled fact rather than an experiment. We have reports on good authority from a score or more of large plants in various parts of the country, from Massachusetts to Minnesota, in which fuel oil is a commercial success. A few reliable tests have been made, and several descriptions of the methods in use have been published, and it may be well to summarize the results and note the conditions which appear to be necessary in order to insure success.

Of the published tests, the following are selected as bearing the stamp of reliability: The Minnesota Brush Electric Co., Minneapolis, report an evaporation of 17 pounds of water per pound of oil from and at 212° Fahrenheit, with the ordinary cylindrical tubular boilers. At the Union Steel Works, Chicago, under similar boilers, an evapora-

tion of 18.39 pounds from and at 212° is given. At Alexandria, Va., a board of U. S. naval engineers reported an evaporation of 16.9 pounds as above, in a locomotive boiler. At Minneapolis and Chicago, Lima (Ohio) oil was used, the burners were fed by gravity, and the furnaces were specially built for oil fuel. At Alexandria the furnace contained a fire-brick table or arch, and the oil is reported as petroleum, but not otherwise identified. In this last mentioned test, the evaporation, as given per pound of oil, weighing 6.85 pounds per gallon, has been corrected for moisture in the steam. No tests of the quality of the steam appear to have been made in the other two tests, which may account partly for the exceptionally high results obtained at the Union Steel Works.

In these three tests three different styles of burners were used, the common features being, as with several other burners, the injector or jet principle used with steam and hot air. As steam is used in operating the burners, it is evident that a deduction must be made from the evaporation per pound of oil as given, before a strictly accurate comparison with coal burned in plain furnaces can be made, and no tests are recorded of the weight of steam so used. The nearest approach to this, as far as known to the writer, is the calculation made by Prof. M. E. Cooley, a few years ago, in connection with a test of a smoke-preventing device. The steam used in this case was calculated to be 0.5 pound per pound of coal, and it would seem to be fair to assume that the steam used for the oil burners would be at least as much as this. Some recent experience with a steam jet smoke-preventing device where the jets were supplied with steam from a small auxiliary boiler, indicates that the weight of steam used by such arrangements is considerably greater than ordinarily supposed. The theoretical evaporation of the oil used at Alexandria was found to be 21.756 pounds, which is about the value usually given for petroleum. Taking the evaporation at 16.9 pounds, the efficiency of the oil was thus 77.8 per cent., or in other words, 77.8 per cent. of the total heat units contained in the oil was delivered as dry steam. This would be equivalent to an evaporation of 11.67 pounds of water from a coal having a theoretical value of 15 pounds, which is, of course, higher than is to be expected in practice. We find here one point in favor of oil, briefly that it is possible to obtain a high efficiency with it under circumstances where it would be difficult with coal.

It is, of course, not to be supposed that the efficiency obtained in these special tests can be maintained in every-day work. It is probable, however, that with proper furnaces and burners, an evaporation of 14 pounds of water per pound of oil can be maintained. With ordinary boilers and poor coal, or when the boilers are forced, the evaporation may not exceed 6 pounds per pound of coal, and it will vary from that up to 10 pounds. If we take these values as limits, a pound of oil is equivalent to from 1.4 to 2.3 pounds of coal. On this basis, and taking the weight of oil as 7 pounds per gallon, we find that, if the price of oil per 42 gallon barrel is $\frac{14 \times 7 \times 42}{6 \times 2{,}000} = 0.343$, that of the 6 pound coal, and about 0.206, that of the 10 pound coal, their values as fuel will be the same, no allowance being made for cost of firing, handling coal and ashes, etc.

The saving in the cost of handling fuel is, however, an important factor, as will be seen from the following data, which is taken from papers read by users of fuel oil at the last meeting of the National Electric Light Association. In Minneapolis a saving of 21 per cent. is reported as the result of substituting oil, at $1.05 per barrel, for Illinois coal, at from $3.15 to $3.50 per ton. In Detroit a saving of 44 per cent. is claimed by the use of oil at 55 cents per barrel, "best bituminous" coal costing $2.80 per ton. In Boston, with oil at $1.15 and Cumberland coal at $4.50, a saving of 15 cents per 100 horse-power per hour is reported. On the basis of four pounds of coal per horse-power, this would be equal to about 18 per cent. In Chicago, where oil costs 60.6 cents per barrel, and Indiana block coal from $3.00 to $3.40 per ton, one user is reported as saying that the saving is 20 per cent., while another says that it pays, on account of the absence of ashes, etc.

The relative cost of a barrel of oil and a ton of coal is at Minneapolis from 0.3 to 0.33, at Detroit about 0.2, at Boston about 0.26, and at Chicago from 0.18 to 0.2. It would follow from these figures, on the basis of a working evaporation of 14 pounds of water per pound of oil, that, as a question of comparison of fuels simply, there would be very little gain by using oil at Minneapolis or Boston, and that it should pay to use it at Detroit and Chicago. A very large proportion of the saving reported must therefore be due to the reduction in the cost of firing and other similar expenses, and to the fact that the heat of the fire can be readily kept fairly constant or regulated at pleasure. This is, of course, difficult with the ordinary coal-fired furnaces, where the furnace doors are being continually opened for putting in coal, and slicing and cleaning fires. The absence of draughts of cold air, with the consequent effects on the boilers, is an item in favor of oil which is not to be despised.

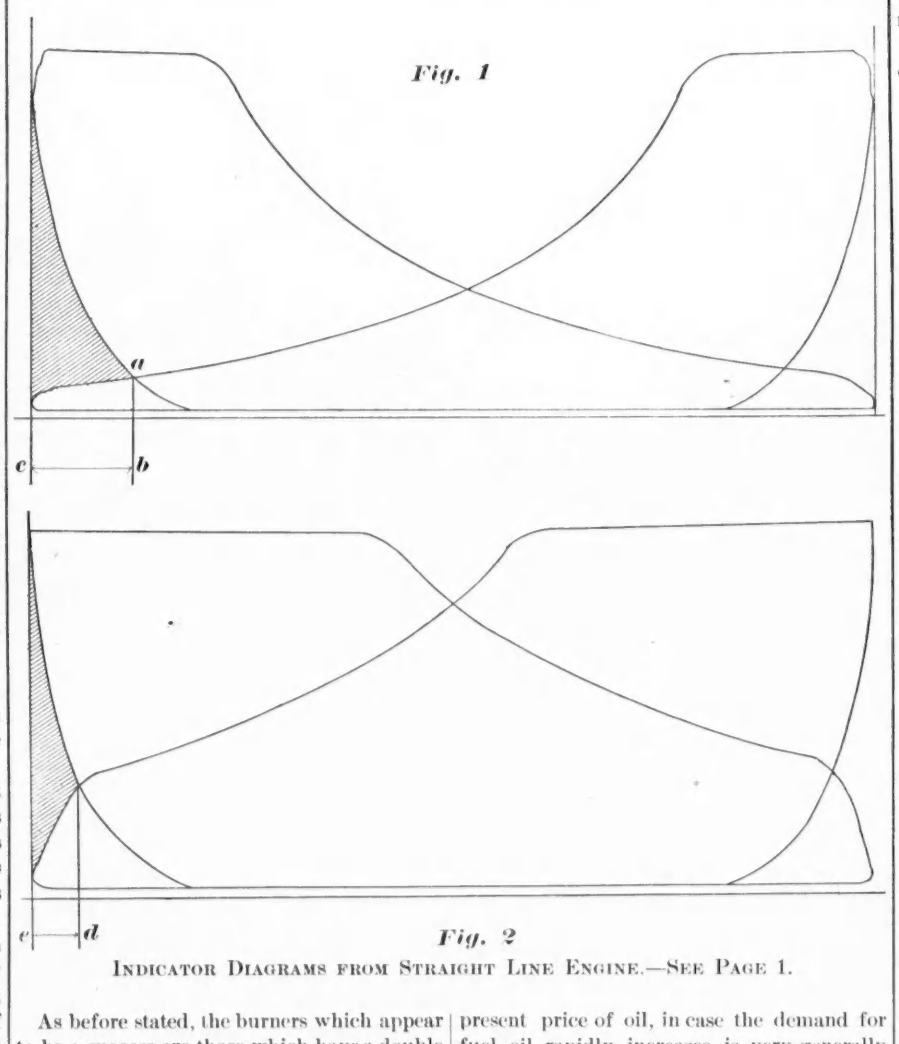


Fig. 1

Fig. 2

Indicator Diagrams from Straight Line Engine.—See Page 1.

As before stated, the burners which appear to be a success are those which have a double nozzle, or its equivalent, and blow the oil into the furnace in the form of vapor or spray by steam pressure, and also supply a large volume of hot air. The opinion of users appears to be without exception that the simplest burner is the best. There are a number of burners on the market which have given good results, while some users have preferred to make their own, so that the selection of a satisfactory burner should not be a difficult matter. Two methods of supplying the oil to the burners are used, viz., by gravity from small elevated tanks, which are supplied by pumps from the storage tanks, and by pressure from underground tanks. Both systems are in successful operation, and both have strong advocates.

The key-note of the successful combustion of oil appears to be in the setting of the burner and the arrangement of the furnace. The furnace should contain plenty of fire-brick surface, which, by becoming heated, will insure the complete combustion of the oil before the vapor or gases come in contact with the boiler. The burner should be set so that the oil vapor will be directed against this brickwork, and not against the boiler. Brick flues, so placed as to become highly heated, should be provided for supplying hot air to the burners. It will be seen that these requirements can be met by additions to the ordinary setting, without disturbing it to such an extent as to render it difficult to return to the use of coal if it should be desirable at any time.

It would seem, then, that, with our present knowledge, the problem of whether or not it will pay to use oil in any plant is a question of calculation rather than of experiment. To solve this problem we must know the cost of oil and coal delivered, the evaporation attainable in daily work from the coal used, the cost of handling coal and ashes, and the additional cost of insurance, if any. With this data it would not be difficult to estimate with considerable accuracy whether or not it will pay to erect the necessary tanks, put in piping and burners, and make changes in furnaces. The question of insurance is undoubtedly a formidable obstacle in some localities, particularly where the ground space for storage tanks is small. It will probably be less formidable when the insurance companies have investigated this subject as carefully as they have some others.

The question of the permanency of the present price of oil, in case the demand for fuel oil rapidly increases, is very generally stated as an argument against its use. The importance of this has apparently been overestimated in many cases, for the conditions which must be fulfilled, in order that the use of oil shall be commercially successful, are such that its general use is well nigh impossible. For instance, the use of oil in small, isolated plants, or where there are poor facilities for the delivery of oil, is certainly not practicable. Further, it is said that it does not pay to refine Ohio oil, and that its principal use must be for fuel, and that the Standard Oil Company will make contracts for fuel oil for a year.

In view of all these circumstances it does not appear that those who are so situated that they can use fuel oil with advantage have any more to fear from the oil monopoly than they have from the coal combination. If complete data as to the efficiency and cost of operating a steam plant is obtainable, it will not be a difficult problem in economic engineering to determine whether or not coal can be successfully replaced by oil.

Almost every town in the country is waking up to the necessity of water-works.

The Erie Meeting of the American Society of Mechanical Engineers.

Secretary Hutton has issued circulars relating to the next meeting of this society, which will be at Erie, Pa., beginning May 14. A list of papers to be presented is given, and information in regard to reduced railroad rates is furnished. The following are the questions that will come up under the head of "Topical Discussions":

72. What form of self-oiling boxes have you found the best for line and countershafting? Can you give figures as to economy of oil as compared with other methods?

73. What form of oil cup or lubricator do you find most economical for use on machines requiring constant lubrication?

74. Have you any experience as to the use of machines for hand or power for facilitating foundry moulding? Can unskilled labor be employed?

75. Is it right or wrong in theory, to put a central support under the bed of engines of the Corliss type? Do you know of any bad results from its use, or from its absence?

76. Does it prevent nuts from working loose, or prevent breakage of bolts, to reduce their cross-section between the head and the nut?

77. Did you ever meet with either of these cases?

1. Did the unequal wear, when a long slide works in short guides amount to enough to become objectionable?

2. Did the unequal wear of a short piece working in long guides amount to enough to become objectionable?

78. Have you tried the plan of applying electro-motors to mechanical operations requiring not more than ten horse-powers? Can you compare their convenience and economy with those of small engines, or the usual transmissions by belting and shafting?

79. Is there any better plan to protect steel from corrosion than to japan it?

80. Have you successfully soldered aluminium? Can aluminium be welded by electricity?

81. Have you any experience in hardening machinery steel, or in case-hardening it?

82. What are the relative advantages of the time-card and the time-book systems for keeping time in factories?

Shop Notes.

It will be remembered that some time ago there was some discussion in these columns as to the relative advantage to a shop owner which would result from the following of one or the other of two distinct plans; the one being to build machinery strictly in accordance with the builder's idea of how it should be built, and rigidly adhering to that ideal, regardless of the wishes or preferences of customers; the other, to build about what seemed to be demanded or preferred by customers, trusting largely to that demand to indicate what would best suit the market and bring the best returns to the builders.

In conversation with Mr. I. P. Connig, foreman of the machine shop at the Fitchburg Steam Engine Co.'s place, he expressed the opinion that the fact of their being crowded with orders was largely due to their practice of building about what a customer wanted, and that, when they had built an engine to suit one man, they were pretty sure to find a number of other men who could be suited by the same engine. But as other shops are to be found which are equally busy, and where the other plan is followed it would seem as though there were arguments in favor of each, with a probability that the best course usually lies in the mean between the extremes, which is really the one followed by most shops, including, probably, the F. S. E. Co. They have evidently outgrown their quarters, the shops being considerably crowded with tools and workmen. A good many special fixtures are used besides jigs and templates for drilling. The shelves in the tool-room are classified, and tools for certain engines kept together. In a book, kept in the room, every tool and fixture is doubly indexed (by its common shop name and by its designating symbol), so

that, by reference to this book, the particular shelf, and division of a shelf in which the desired tool is to be found, is readily ascertained.

A horizontal engine which they build has a bed of the girder form, and bored guides, the center of the bar by which they are bored being fixed in the center line of the engine. There is no room back of the guides in which the cutters can swing round, and, consequently, a device was invented for the work, which consists, essentially, of a stiff bar which is attached to the bed by suitable brackets, so as to lie in line with the center line of the cylinder. On this bar, which does not revolve, but is fixed stationary, is a boring head which is a working fit upon the bar, and carries two cutters. The head consists of a sleeve, which is fed along the bar by a screw in the usual manner, while upon this sleeve is fitted a collar, which is the head proper. This is given an oscillating motion upon the sleeve, by means of a short connecting rod, which is attached to an arm upon the head, the other end being attached to a crank, which is driven by suitable gearing, and a shaft which runs along parallel to and above the bar. The cutters are thus given just enough motion to sweep back and forth across the face of the guides, and, there being two cutters, both guides are bored simultaneously. It is a very ingenious device, and it is difficult to imagine one better suited to the purpose or more effective. Another noteworthy device of Mr. Connig's is an improvised taper attachment, which he constructed to bore the taper holes in a part of the steam valves of the engine. These are piston valves, and are so made as to be capable of expansion, to compensate for wear, this expansion being effected by means of a taper plug which fits a taper hole bored in a sleeve, which is split and is cylindrical outside. To fit an ordinary lathe for boring this taperhole, a sliding block was fitted to the cross slide of the carriage, and provided with a gib and screws for the maintenance of a good fit, the same as the regular tool rest, in front of which it was placed on the cross slide. The top of this new block was plain and flat, except that a stud was driven into it, and stood up above its upper surface about half an inch. The nut for the cross feed screw was taken off from the tool rest and attached to this supplementary block instead, so that it could be moved by the screw, while the tool rest was free to move independently of the screw. In the top of the tool rest, and in front of the tool post, was a stud corresponding to the one mentioned in the top of the supplementary block. A rectangular plate of cast-iron was provided, somewhat longer than the depth of the hole to be bored, and upon one face of this plate were planed two straight grooves, which fit over the two studs spoken of. These grooves were not parallel one to the other, but diverged at the angle necessary for the desired taper. When this plate was in position with the groove over the studs in the tool rest, and in the supplementary block, these latter were of course joined to each other by means of the plate; and if the cross feed screw be turned they would both move together. The plate is attached to the foot-stock by a bar in such a way that it cannot move when the carriage is moved along the bed, but is free to move back and forth by the cross feed screw, the result being that the tool can be put to the cut in the usual manner, and the feed put on, when, the supplementary block being held by the cross feed screw, and the plates being prevented from partaking of the motion of the carriage, the tool rest is moved in or out, corresponding to the divergence of the grooves, and the desired taper is produced. Though this, of course, provides for one taper only, different plates can be provided for different tapers; or, in place of the plate, there could be two bars, each having a groove, and hinged together in such a manner that any desired taper could be obtained. Or one of the grooves could be of any irregular shape, if desired, so that any form could be reproduced at pleasure.

For measuring work up to six inches or more by thousandths, they have a tool made much like a slide gauge, having two jaws fitted to a bar, to which they can be clamped by thumb-screws. An ordinary one-inch micrometer was cut in two, leaving on each end enough of the bow to attach it to the ends of the sliding jaws. A set of standards enables the tool to be set to any desired size by adjusting the jaws, after which, variations from that size may be measured by the micrometer screw.

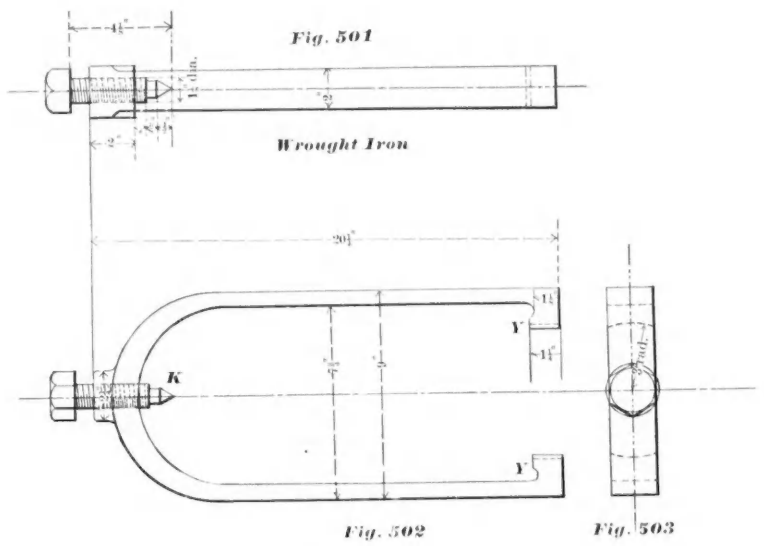


Fig. 501 Fig. 502 Fig. 503

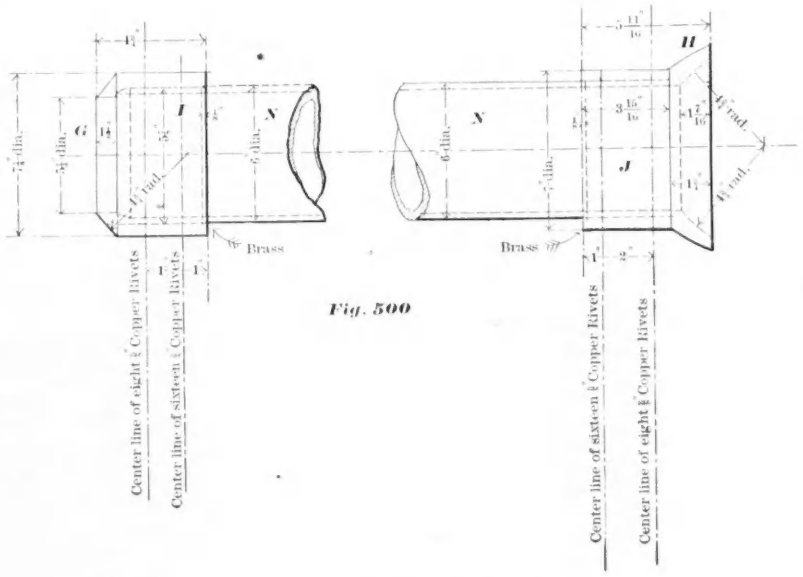

Brass
Brass
Center line of eight ⅞" Copper Rivets
Center line of sixteen ⅞" Copper Rivets
Center line of sixteen ⅞" Copper Rivets
Center line of eight ⅞" Copper Rivets

Fig. 500

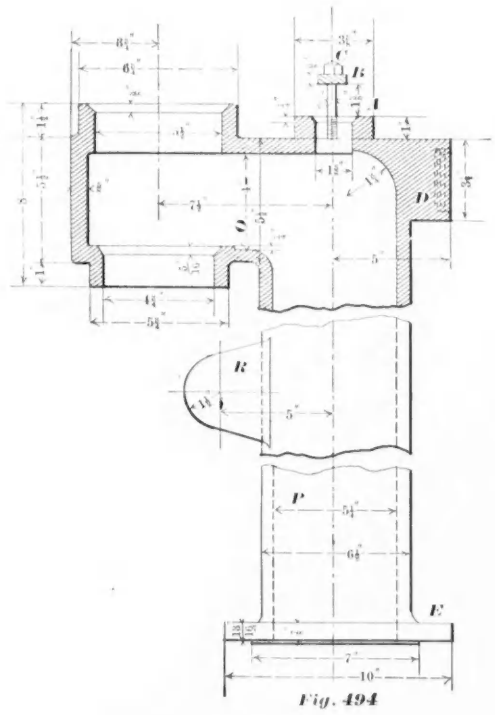


Fig. 494

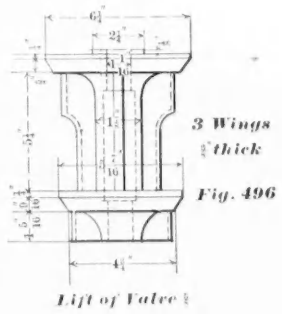


Fig. 496

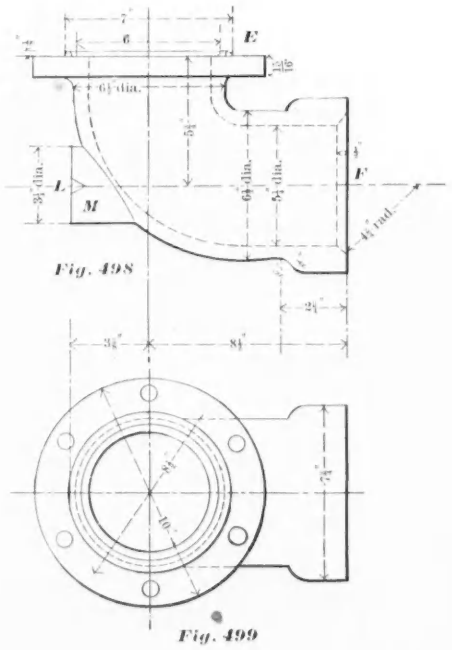


Fig. 498 Fig. 499

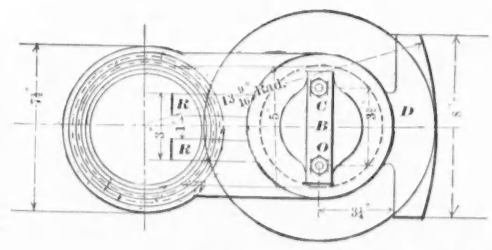


Fig. 495

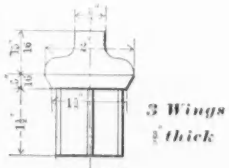


Fig. 497

Modern Locomotive Construction.

BY J. G. A. MEYER.

NINETIETH PAPER.

Figs. 494, 495 represent another design of throttle pipe; Fig. 496 represents the valve. The principal difference between the throttle pipe shown in Fig. 493 (last paper) and the one shown here, is that the latter has at the top a seat *A*, for a small relief valve which is shown in Fig. 497. The object of this relief valve is to prevent the dry pipe *N N* (Fig. 500) from bursting, which, without this valve, is liable to occur when the engine is suddenly reversed. Springs are not used for holding this valve on its seat; the steam pressure in the boiler is sufficient to do so. When the valve does lift, it is prevented from lifting too high by the small wrought-iron plate *B*, held in position by the two studs *C, C*.

The elbow, Figs. 498, 499, is bolted to the throttle pipe; the joint is a ground joint.

The dry pipe *N N* is made of wrought-iron; the thickness varies for different sizes of pipes from $\frac{5}{32}$ to $\frac{5}{16}$ of an inch; the former thickness is that of pipes 4 inches outside diameter. But dry pipes of the same diameter will not always have the same thickness, as master mechanics will increase it to suit the steam pressure in the boiler; the thickness is also frequently increased for pipes longer than the average length of pipes. Dry pipes 7 inches outside diameter are the largest that we have seen used. We believe that for this size of pipe a thickness of $\frac{5}{16}$ of an inch is sufficient for the greatest length required in any locomotive. The smallest outside diameter of dry pipe that we have seen used is 4 inches; the diameter for the next size of pipe is 4½ inches; the diameters of pipes larger than this increase by one inch. Dry pipes, like boiler tubes, are designated by their outside diameter.

A sleeve, generally made of brass, is attached to each end of the dry pipe. In some cases the dry pipe is slipped over the sleeves, but frequently the sleeves *I* and *J* are slipped over the dry pipe, as shown in Fig. 500.

When the diameter determined by the rule which we shall give presently agrees with one of the standard inside diameters of pipes, the best practice is to put the dry pipe inside of the sleeves.

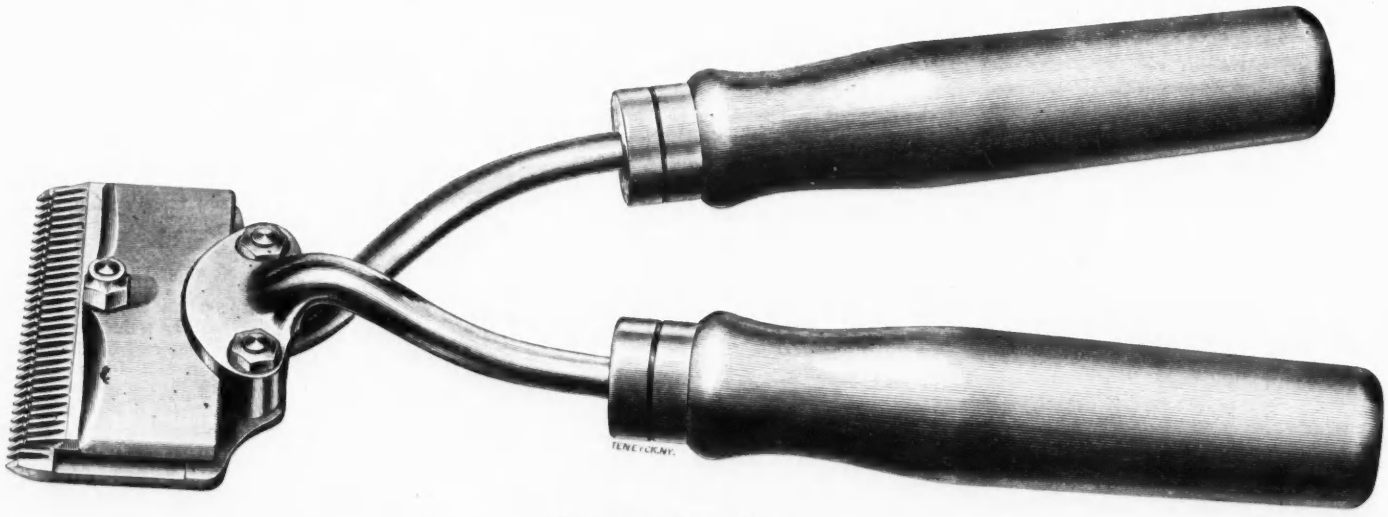
Some master mechanics shrink the sleeves onto the pipe; others fasten them with rivets, generally ⅝ of an inch diameter. Two rows of rivets, from 1½ to 2 inches apart, are used. The distance between centers of rivets is generally from 2 to 3 inches. The rivets are arranged zig-zag; in some instances twice as many rivets in one row as in the other are used, as shown in Fig. 500. Frequently, instead of using rivets, the holes through the sleeve and dry pipe are tapped, threaded plugs screwed in, and their ends slightly riveted over, to prevent them from turning and falling out. In our opinion, the best practice is to use iron rivets or plugs; copper rivets should be avoided, as the action of some kinds of water will produce corrosion between the iron and copper, and consequently leakage.

When the sleeves are placed on the outside of the pipe, and fastened with rivets or plugs, as mentioned, the sleeves are calked; or if the shape of the sleeve will allow it, the ends of the pipe are calked. Pipes placed on the outside of the sleeves always have their ends calked, and sleeves shrunk on the pipe are frequently not calked. Sometimes the ends of the pipe are threaded, and the sleeves screwed on; in such cases, calking will be a detriment.

The end *G* of the sleeve *I* is turned to a spherical form, and the elbow at *F* (Fig. 498), is counterbored to a similar shape, so as to make a ball joint between the two. For connecting the dry pipe to the elbow, the yoke shown in Figs. 501, 502, 503, is slipped over the sleeve *I* and the elbow *F*; the lugs *y y* are made to bear against the flat end of the sleeve, the point *K* of the set screw is inserted in the countersunk cavity *L* in the lug *M*, and the sleeve *I* drawn tightly against spherical face *F*, and firmly held there. Although this mode of fastening the dry pipe to throttle pipe is often used, and gives good satisfaction, other designs for accomplishing the same thing are adopted; for instance, for a throttle pipe like that shown in Fig. 493, two hooked bolts instead of a yoke are used. But in all cases the joint between the throttle pipe and dry pipe is a ball joint, which affords ready means for adjusting the dry pipe to any inaccuracies which cannot be avoided in the construction of a boiler. The sleeve *J* at the other end of the dry pipe is also made so as to form a ball joint, with a casting riveted to the front flue sheet; this casting or ring will be presently shown.

Improved Horse Clipper.

We illustrate upon this page the recently improved horse clipper made by the Brown & Sharpe Mfg. Co., Providence, R. I. As now made, one of the handles is enlarged where it joins the bottom plate, to which it is attached by two screws which are threaded into the handle, and in addition have nuts placed upon top. On the under side of this piece is a stud which is solid with it and passes through the bottom plate, the other handle working upon this stud as a pivot. Beyond the pivot it has a projection which engages with a rectangular opening which is made in the back of the top cutting plate. On this plate is another one, which, on the under side, has two studs projecting from it, which are square in section and fit square holes in the bottom cutting plate, the holes in the top cutting plate being long enough to allow of the necessary cutting motion. The upper plate is held in place by a single small bolt, the head of which, as well as the bottom of the nut, has a spherical bearing, in order to insure an even distribution of pressure along the top cutting plate. Projections are left upon both cutting plates, which are thick enough to admit of repeated grinding to sharpen, which is done upon the flat surface only, the cutting action depending upon the accurate fit of these surfaces to each other and the sharpness of the corners of the teeth. The instrument is nickel-plated, with case-hardened screws and nuts, and is a good example of modern production by special machinery and tools.



IMPROVED HORSE CLIPPER.

The Modern Steam Plant and Its Management.

BY PETER H. BULLOCK.

SAFETY VALVES AND OTHER FIXTURES.

Before discussing safety valves, I wish to speak of gas and water gates that have bell and spigot ends. Where one of these joints is to be made, be sure that the gate is closed, so that, if any of the melted lead leaks by the packing, it will not flow into the space between the seats, preventing the gate from going low enough to be tight, as shown in Fig. 7. Several pounds of lead in the gateway of a 12″ water-works gate caused a leak that very seriously interfered with the work of connecting a Worthington pumping engine that the writer had arranged for entertainment on a certain holiday. Had the gate been closed down tight when the joint was poured, this lead could not have got there, even if it had leaked by the packing, which it would not have done had the work been properly performed.

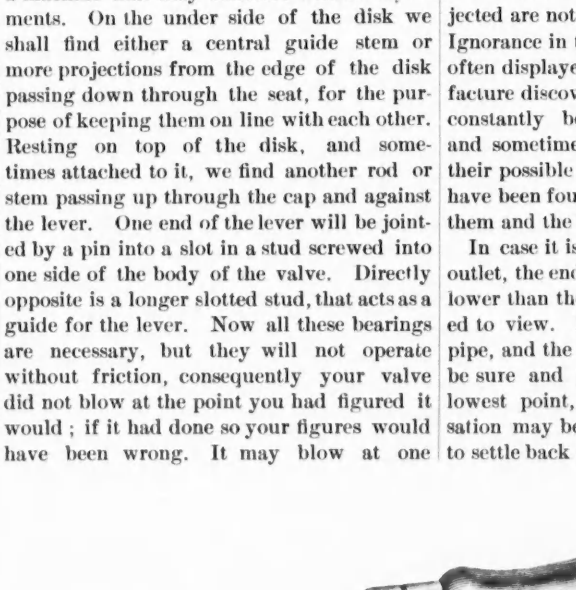


Fig. 8

Fig. 7

THE MODERN STEAM PLANT.

SAFETY VALVES.

Safety valves are placed on steam generators for the purpose of relieving them of any pressure above that required for use, or set as a limit of safety. Rules for calculating the pressure of safety valves under various conditions and pressures are to be found in the pages of nearly every mechanical paper one can pick up. Also full and elaborate formulæ are given in all books treating the subject of steam. It is not my intention to encumber these pages with any further, as it has been so fully and plainly treated by others.

I will presume, therefore, that my readers are aware of the area of their safety valves exposed to pressure, or are competent to ascertain that fact; also that they are aware of the weight of the materials that oppose the movement of the valve from the seat, and all the particulars of leverage and fulcrum, and are competent and willing, by the aid of any of the rules before mentioned, to figure out the pressure that should cause the valve to open at any position of the weight.

Assume that you have a steam gauge that is exactly right (probably you have not), and you get up steam to the point where the valve should blow, and it does not do so. Let us see what there is about the valve as a machine that may interfere with its movements. On the under side of the disk we shall find either a central guide stem or more projections from the edge of the disk passing down through the seat, for the purpose of keeping them on line with each other. Resting on top of the disk, and sometimes attached to it, we find another rod or stem passing up through the cap and against the lever. One end of the lever will be jointed by a pin into a slot in a stud screwed into one side of the body of the valve. Directly opposite is a longer slotted stud, that acts as a guide for the lever. Now all these bearings are necessary, but they will not operate without friction, consequently your valve did not blow at the point you had figured it would; if it had done so your figures would have been wrong. It may blow at one pound, or it may take five more than you figured; if anywhere near the latter amount, give that valve attention right away.

THINGS THAT MAY CAUSE BINDING OF THE VALVE.

The guides to the disk may have moved easily, but close when made; but when hot and under strain they may bind, from causes explained in a previous paper. If this is found to be the case, the parts should be draw-filed to an easy fit. The stem from the top of the disk to the lever may bind through the cap. This is quite likely to be the case where it is made of iron or steel. If this is the faulty part, draw-file this, polish it, and rub the surface with graphite. The pin in the lever or the slots in the studs may also bind. They require to be kept free from rust and dirt, and should have their surfaces covered with graphite. It is not well to use oil of any kind on these parts, for it quickly dries up, and the sticky surface soon becomes coated with dust and dirt. If all these parts work well and free, the valve will begin to blow very soon after the figured point has been reached, and will stop blowing as soon as the pressure goes below where it started.

All this comes from the valve being required to operate the machine, or the parts necessary for its control. If the writer was called upon to design a safety valve that would positively not allow the pressure to go above a certain point, it would take the form of a balanced valve *operated by a machine*, perhaps similar to some of the sensitive danger regulators. Where it is more convenient to have the lever and weight on one side than the other, it is only necessary to shift the slotted studs or to half turn the cap when the guides are cast solid to that part.

What has been said thus far refers to the most common style—the plain lever and weight valve of ancient and respected lineage. There are numerous patterns of spring valves, some of which are excellent in material and make, those usually found on locomotives being models of efficiency and reliability.

All the ills to which safety valves are subjected are not inherent in their make or form. Ignorance in their setting and use are more often displayed than are faults in their manufacture discovered. Cases of overloading are constantly being met with by inspectors, and sometimes to an extent that precludes their possible operation; and sometimes they have been found with a stop valve between them and the boiler.

In case it is found necessary to pipe the outlet, the ends of the pipe should be slightly lower than the valve, and, if possible, exposed to view. If there must be fittings in the pipe, and the outlet be higher than the valve, be sure and provide a drip pipe from the lowest point, so that all water of condensation may be drained off, and not allowed to settle back to corrode the seat or stem.

There was a boiler located in the cellar of a building where there was but 9″ between the top of the boiler and the timbers above, and the valve nozzle was so high that there was not room for the safety valve on top of it; consequently they put on a flange and some fittings and located the valve down and to one side of the boiler. This made a nice little trap, that held about four gallons of water. This was a very quiet valve; it did not want to blow very often, and when it did there was no preliminary sizzling; it just began to blow, first, of course, coming the water, and then good honest steam. Hall Peters was engineer there, and had received several baptisms from this caloric fount, and had protested to the proprietor against its continuance. One day the owner went to the engine-room for a consultation regarding matters and things, and Peters slyly opened the draft and awaited results, at the same time corraling the owner into a favorable position for a surprise, which very soon came, wetting him some, and scaring him into ordering the necessary changes made. He had never paid any attention to complaints about it, but this object lesson convinced him.

There are other things on top of a boiler besides the safety valve, and they are not always right in make or position either.

Manhole frames will sometimes be found where it is almost impossible to get or keep the plates tight. This is owing to the fact that the plate and frame do not fit each other, and the cause may be either in the original casting of the frame or plate being sprung out of true, or it may be that the frame was true when cast and before it was riveted to the shell; but when the latter becomes hot, and under pressure, any imperfections in the curve of the frame, will, in a greater or less degree, be corrected by the shell in its tendency to assume a true circle. Of course this movement will be small, but it may be enough to throw the strain to the ends or sides of the plate, as the case may be, thus allowing the steam to leak on the opposite sides.

Sometimes the frame will be found cracked, which is almost a sure sign that there is an unequal strain by the bending of the frame, and when this has happened the boiler should not be run until repaired. More frequently, however, the leaks around the manhole will be found to be owing to small pieces of burned packing being left stuck to the plate or frame. A very small piece of this will be enough to cause a leak.

After the plate has been put in place and drawn up as tight as possible with the nut, it will be found to be quite loose after steam has been raised, and the plate should again be drawn up tight, when it will probably remain so. If not drawn up, the first time steam goes down, the plate will drop, either from its own weight or the vacuum that will occur if the boiler is not provided with a vacuum valve, as all boilers should be, and particles of dirt may be sucked in and lodge on the packing, causing a leak when steam is raised again. You may think you can draw the plate up pretty tight with a wrench, but it is as nothing to the pressure of the steam, which in the case of a 11 x15 plate with round corners, and 80 lbs. pressure, is 11,120 lbs. By facing the side of the gasket next to the frame with graphite, it will usually come off with the plate, and frequently the same one can be used several times. Where a plate is found to leak at any point, and you are sure that it and the frame are clean, you can build up the gasket at this point by pasting on strips of cloth or thin packing with its ends skived down to an edge.

Not very far from the manhole we shall find the stop valve. Now if there is any one thing around the whole plant that needs to be tight, it is these stop valves. If it is necessary to do any work on the main pipe, you want those valves to keep the steam back so you can work. If it is necessary to enter one boiler when steam is on the rest, you want the stop valve of that boiler tight, and

no fooling with or about it, either, while you are inside. It is about as bad as can be to enter a boiler with steam leaking into it from other boilers, without having to be haunted by the fear that some idiot may open a valve that will smother or parboil you. When laying on the tubes with your arms and legs all mixed up with the braces, you haven't got much of a chance to make a run for the manhole when you hear the ominous sizzle of approaching fog. The writer has been there getting scaled, scared and mad, and there is a man now in Pennsylvania on whom he tried to impress his displeasure at being interrupted in his inspection, by transferring a fac-simile of an eleven-boot to the most accessible part of his anatomy. If there is any place where a good reliable double-seated valve is needed, it is for the main stop of the boiler. Especially is it desirable that stop valves be tight and without pressure on the stem packing where there are several boilers all of which are not in use.

There should be as few turns as possible between the boiler and the main steam pipe, and there should be no pockets in it to hold water when the boiler is not in use. Fig. 8 shows how a set of boilers were very improperly piped. *B* is the stop valve and *A* is the main steam pipe on which there was to be steam at all times from other boilers. Now, when you wish to start up a boiler piped in this way, you have either got to send a few pails of water into the steam pipe if the pressure in the boiler gets the highest, or you must let it down into the boiler, with a few deafening bangs from the horizontal part of the pipe, if the pressure in the boiler is the lowest. If the pipe and valve had been arranged as shown in the dotted lines it would have saved one fitting, one 90° turn in the steam, besides doing away with the objectionable water pocket.

The Yost Writing Machine.

Last week we published a communication under the heading, "Forced Alignment for Type Writers," in which the writer, while not calling in question any statement made in our description of the machine, does raise some points that possibly call for a word in the way of explanation.

The article was written by an engineer connected with this paper, after a personal examination of the machine and seeing it in operation. We see no greater difficulty in making these type uniform in large quantities than are met and overcome almost daily in manufacturing operations. As to the question of alignment in manifolding, perhaps the type will come sufficiently near to secure as good alignment as is secured by other methods, though we cannot say positively as to that. When ink or dirt become caked onto the type, they must be cleaned the same as in other machines; but we think the beveled surfaces will remain clean long after the face of the type require cleaning. As to unequal wear by reason of some letters being used more than others, this is provided for so far as hardened steel surfaces will go, and the type are actually furnished for a few cents, the work of putting them in place being extremely simple, and requiring less than a minute of time, as proved by actual trial in the presence of the writer.

As to the wedging action on account of dirt, we should say that it would make the key action "slow and heavy," but the practical question would be, how long the machine could be used before this would take place, and how long it would take to clean it?

It is scarcely necessary for us to say that we have no interest in the Yost or any other writing machine, beyond what is interesting to our readers as mechanical news.

Notwithstanding the collapse of the copper syndicate, it appears that its representatives are still trying to "fix" the price of copper. Better fix the price of the stock of the syndicate.

A Problem in Coal Haulage.

The Lens Colliery Company has satisfactorily solved an interesting problem. The development—thanks largely to the use of compressed air—of one of their deep seams, 1,100 ft. from surface, rendered necessary the addition of a third deck to the cage. But with this additional weight the engine was found unequal to the task of drawing the load. The difficulty had, however, been foreseen, and in part provided for. A special engine has been erected to condense the steam in the air-compressing, pumping, and ventilating engines. A few hours' work was sufficient to connect this with the winding engine. The success was complete. By means of this condensation the engine has been rendered capable of drawing 1,000 tons a day from the depth mentioned. The stroke is 1.60 meters, and the diameter 0.70 meter. The principle of condensation is likely in future to be generally applied to winding engines. All examples hitherto, so far as can be learned, have given satisfactory results.—*Colliery Guardian.*

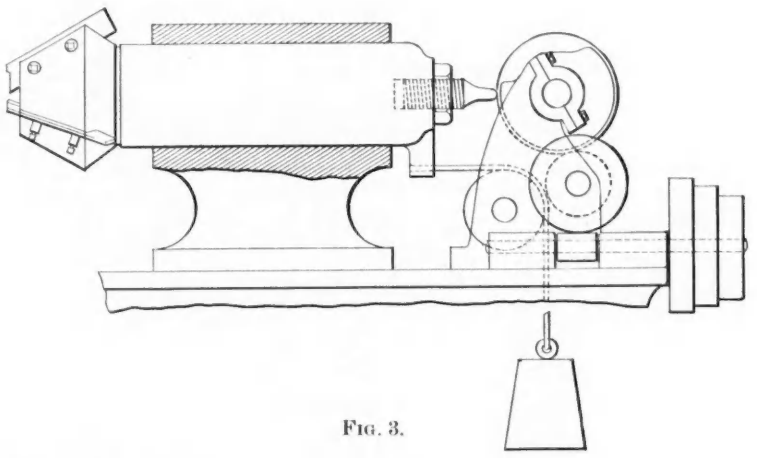


FIG. 3.

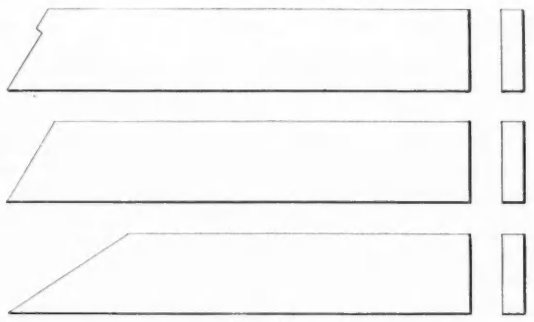


FIG. 2.

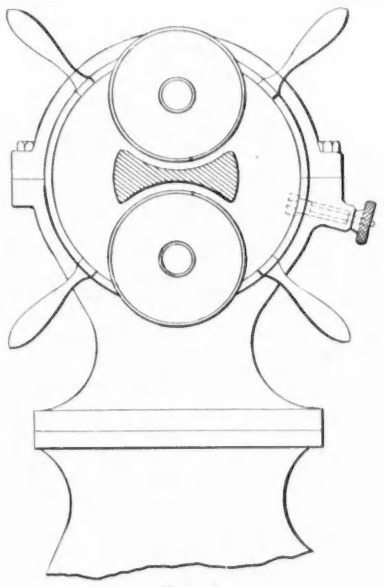
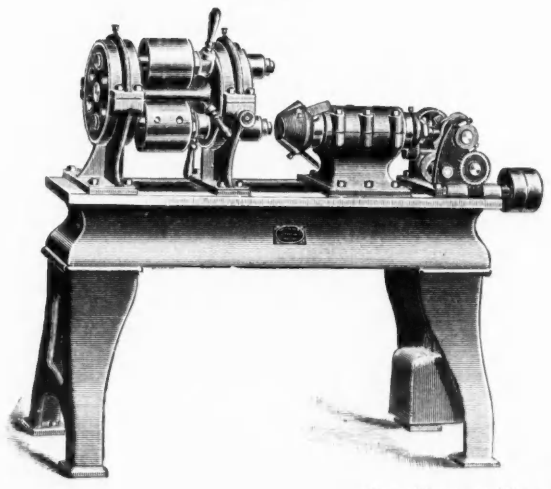


FIG. 1.



NUT FACING MACHINE.

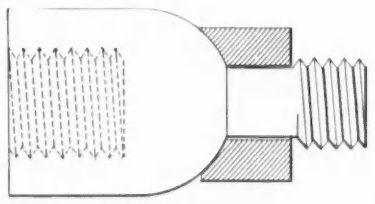


FIG. 4.

The Nicholson Nut Facing Machine.

We have previously illustrated several tools of a new system of machinery for finishing bolts and nuts made by Nicholson & Waterman, Providence, R. I. In our issue of Sept. 24, 1887, we illustrated and described the machine for finishing the sides of bolt-heads and nuts, called by the makers a "Broaching Milling Machine."

In this issue we show the perfected companion tool—that for finishing the tops and bottoms of nuts, and the tops of bolt-heads, being a part of their system for finishing nuts and bolt-heads for locomotive, engine and general machinery.

The object of the machine is to finish the tops of nuts and bolt-heads in any style preferred, or to face the bottoms of nuts, at the same time relieving the outer corners and chamfering the first thread.

Two spindles are used, which are mounted in a revolving head, so that, by drawing out a spring pin, and taking hold of any one of four handles, either spindle can be brought down in line with the cutter spindle. As the pulley on the countershaft is larger than those on the two spindles, the belt always clears the uppermost pulley while driving the lower one. The arrangement is shown by the outline cut, Fig. 1, which is a section of the head just back of the pulleys. The cutters are made of straight plain pieces of steel with the ends ground to the proper shape as shown at Fig. 2. These cutters are set into a head of conical shape and fastened by set screws, as shown at Fig. 3. The plunger to which this head is attached does not revolve, but is moved back and forth by the combined action of a cam and a weight. This cam is placed behind plunger, and is driven by suitable gearing and a worm with an independent belt. The cam can be made to revolve faster or slower, according to the nature of the work or the activity of the workman, and is so formed as to advance the cutters slowly and let them recede rapidly, keeping them back just long enough to allow the operator to pull the spring plunger bolt and bring the upper spindle down into line. While the cut is being made, the nut or bolt which has just been finished is removed from what is then the upper spindle, and another one substituted, ready for the next cut. In this way no time is lost in changing the work, and the reciprocating motion of the plunger can be made as rapid as possible, every stroke it makes representing a finished surface, provided, of course, the machine be faithfully attended to by the operator.

Nuts are held upon arbors, Fig. 4, which screw onto the spindles and have a washer with spherical seat, to allow it to adjust itself to any irregularities upon the face of the nut and come true with the thread. Bolts are held in universal chucks, the spindles being made hollow, so that bolts up to 20″ in length can be finished. The spindles run in hardened conical bearings which can be adjusted for wear, and the spring plunger bolt is tapered, hardened, and fits into hardened bushings. The spindles being exact duplicates of each other, and the motion of the cutter spindle always the same, uniformity of work is easily secured.

Graphite for Preserving Wire Rope.

Graphite is now used for the preservation of wire rope, for which purpose it is said to be particularly adapted. The graphite is specially prepared for this use, being mixed in the form of a grease. It can be applied in various ways, one of the best it is said, being by means of a trumpet-shaped tin tube, the small end fitting the rope and the larger end of sufficient size to carry two or three pounds of graphite grease. The rope traveling through the tube coats itself nicely, a coating once in two weeks being generally sufficient.

It is said the graphite prevents rusting, and also saves the rope from abrasion when coming in contact with hard substances, as well as prevents the wires from abrasion by rubbing one against the other, as the graphite finds its way into the spaces between the wires, being helped and held there by the grease. A well-known mining engineer says the use of graphite as above will double the life of wire rope.

Personal.

Simpson Bolland, well known to the readers of the AMERICAN MACHINIST, through his contributions on foundry matters, has accepted the foremanship of the foundry department of the De Lamater Iron Works, of New York City. Mr. Bolland is an experienced foundryman and has before this had charge of important works. His present position will give him ample opportunity to plan and execute, as some of the best foundry work done in the country is done at De Lamater's. We congratulate Mr. Bolland upon being selected for such an important position.

Stanley's Machine Gun.

The prints of the English-speaking world have been full of stories about the machine gun which Henry M. Stanley carried with him in his last desperate venture in Africa. And yet it is an old story. It occurs to this paper to properly tell it: The weapon so much talked about is a Maxim gun. It was invented by a citizen of these United States. He was poor and sought encouragement from our Government. He got none. He went to England, where they saw its merits at once, and made him rich. So his gun is under control of the British Government. At the time when he commenced his investigations the three great machine guns of the world were the Gatling, the Hotchkiss, and the Nordenhoff—the first two American, the last English. There was little difference in their merits, save that the Hotchkiss was lighter and made for ready transportation. Maxim, an American boy, said to himself: There are faults about these machine guns: 1. The turning of the crank prevents anything like an aim. 2. Often the cartridges hang fire a little, but the crank turns on, and they explode at the wrong time. 3. Most of all, the rapid firing heats the gun, so that it is useless, and even dangerous, in a few seconds. The Maxim gun overcame all these defects. It is automatic. It needs no crank. Pull the

trigger once and it continues to load and fire itself so long as the supply of cartridges lasts. The power of "the recoil" does all the work, even to shooting a jet of water along the barrel to keep it cool. It fires 700 shots in a minute, and all that the operator has to do is to aim it. This is the Stanley gun. You cannot see it in the United States now, for it is owned by the Government of Great Britain.—*Cincinnati Enquirer.*

The Engineer (London) describes a new calculating rule made by J. Davis & Sons, London, which seems to be a considerable improvement upon the ordinary slide rule. It is of the Grant type, 10″ long, of wood into which are fitted strips of hard white celluloid, on which the graduations are placed, the lines being black. The strips are said to be entirely without relative change in varying temperature, and a degree of accuracy is obtained superior to what has heretofore been accomplished.

"The calculations that may be performed by the aid of this rule are endless in number. In addition to the ordinary processes of multiplication, division, evolution, and involution, it may be used for a variety of technical calculations in which its use effects an enormous saving of time. Thus, the engineer may compute the strength of beams, moments of inertia, horse power of engines, hydraulic formulæ, areas of circles and ellipses, cubic contents, weights, conversion of British into metric or other systems of measurement, without putting down a single intermediate quantity. The electrical engineer may solve all problems involving the application of Ohm's law of the relation between current, electro-motive force, and resistance. The surveyor may plot surveys by rectangular co-ordinates and set out curves. The chemist is enabled by its aid to calculate percentage compositions rapidly. The mode of using the slide-rule may be learnt by any one with no mathematical training in a very short time, and rapidity and accuracy are merely matters of practice. As the results obtained are quite accurate enough for practical work, the slide-rule, now that it can be obtained at a moderate price, cannot fail to come into more extended use amongst engineers, electricians, chemists, and all to whom saving of time and of mental effort is of importance. . . . . No one who has once learned the use of this kind of rule will ever go through the laborious work of any calculations by the ordinary methods."

LETTERS FROM PRACTICAL MEN.

Drawings for Pattern Makers.

Editor American Machinist:

I have no desire to unjustly criticise Mr. Crank on the above subject, but to fairly state my reasons why it is not advisable for the draftsman to make full size drawings for the pattern maker, and this I tried to do in your issue of April 4.

I think Mr. Crank's remarks—April 18—are irrelevant, for it is evident that he fails to understand the practical use of the full-size drawing in the pattern shop. His own words are his judge in this, for he answers my question by asking another that he supposes to be inconsistent. The drawing that Mr. Crank advocates is really not a full-size drawing of the pattern, but of the finished casting; and this being so, I will repeat what I have said previously, that such a drawing is of no more use to the pattern maker than a scale drawing, for he has to do by the one the same as he would have to do by the other, viz.: to transfer the lines on a board for building his pattern. Mr. Crank has so misconstrued my remarks and switched off the track that I cannot follow him further.

P. S. Dingey.

Loss of Power Due to Slip of Belt.

Editor American Machinist:

The following seems to me the simplest way of ascertaining the loss of power due to slip of belt described by Mr. Richards in your issue of Feb. 7:

Ascertain the H. P., at the driving pulley, by means of a friction brake and platform scale, as in Fig. 1.

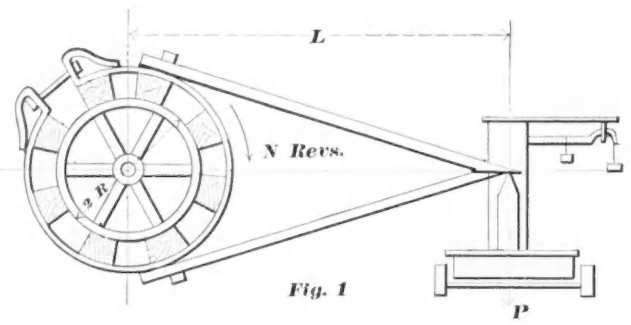


Fig. 1

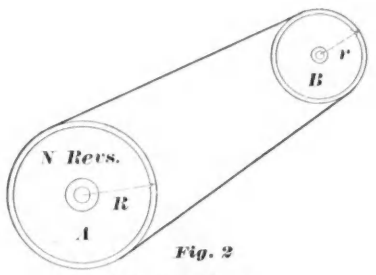


Fig. 2

Slip of Belt.

R = radius of pulley in feet,
N = revolutions per minute,
L = distance to bearing point in feet,
P = pressure on scale,

$$\text{H. P.} = \frac{2\pi R N P L}{33{,}000\ R}$$

Let A and B, Fig. 2, be the two pulleys. Find the actual number of revolutions of B by a revolution counter.

Let N' = revolutions of B, if there were no slip $= \left(N' = \frac{N.\ R}{r}\right)$

N'' = actual revolutions of B,
$H.\ P.''$ = actual horse-power at B.

Since the horse-power varies directly as the number of revolutions we have:

$$H.\ P.'' : H.\ P. = N'' : N'$$

$$H.\ P.'' = \frac{H.\ P.\ N''}{N'}$$

Loss $= H.\ P.—H.\ P.''$

John R. Slack.

Three or Four Flutes.

Editor American Machinist:

A correspondent in your issue of April 4th asks if two taps of same diameter are cut, one with four grooves and the other with three, will one cut larger than the other? Having made thousands of taps accurate to gauge, I will volunteer an answer. If they are machine taps, I have found the one with three flutes to cut the smallest; say machine runs at 250 revolutions, the tap with three flutes creates more heat through friction than the other tap; consequently, a nut off the three-fluted tap shrinks more than one off the other tap on becoming cold, and there is a decided difference in the fit of nut on gauge. A four-fluted tap gives best results, as there is more room for cuttings, it is easier to sharpen, has a better bearing, and don't heat up so.

O. M. Hubner.

New York City.

Wet Steam as a Lubricant—Expansion Joints.

Editor American Machinist:

In Mr. Bullock's notes on the management of the "modern steam plant," he states that condensed steam, or water entrained in steam pipes leading to engine cylinders, has the effect of taking off the oil from cylinder surfaces, or, in other words, water will unlubricate a cylinder. I have used a steam-feed cylinder with a diameter of 8″ x 30 feet travel of piston, what is called the "shot gun feed," for saw-mill carriages. A lubricator had been used for two years on this cylinder, and the bore was in good condition. It occurred to me, however, that the cylinder, being over 100 feet from the boilers, was getting wet steam, a quality of "fog," which should do its own slipping. I took off the lubricator. We started up, and I did not hear any moaning or grunting from the Long Tom. I looked it over once or twice during the season, and it seemed all right. On laying up in December I stripped it for a close examination, and found a burnished surface.

Planting a light at one end, and sighting from the other, I found this cylinder surface, which had been deprived of oil, presenting a mirror-like sheen of smoothness, the entire face from end to end unmarred by a single blemish. The packing rings on piston head were of the "spring" variety—sprung over the head into grooves.

This experience is not at variance with Mr. Bullock's statement, as there was no oil to wash off. It would go to show, however, that oil was unnecessary for this long-distance steam telephone.

Mr. Bullock's views on the utility of expansion joints are the views of the majority of engineers.

The Hartford *Locomotive* has no use for them in any steam connection; prefers the copper U, or a right angle in iron pipe. A correspondent of the *Locomotive*, hailing from Ann Harbor, Mich., I think, takes issue with the editor, and avers that he has used expansion joints in long lines of pipe, is now using them, and never had any trouble from them. They are, I presume, of the slip joint pattern. The commercial expansion joint—that of the pipe and supply shops—is a poor, unsatisfactory thing.

The copper double-flanged expansion joint, used for many years on the heads of the side pipes of American beam engines, is an elastic joint, or I am much mistaken. It takes up very little room, and is safe.

D. W. L.

The Glass Tube and the Steel Bar.

Editor American Machinist:

Some unidentified gentleman asks in your last issue, why a glass tube will crack if a bar of hardened steel be "introduced" into it. I suggest that it may be for the same reason that it takes more power to pump water into the *bottom* of a tank; or that causes the top and bottom of a wagon wheel to provoke so many questions. If I am entitled to *three* guesses, would submit as the third, that possibly the steel bar was too large, or the glass tube too small.

Newton, Mass. Sterling Elliott.

Force in the Steam Engine and Its Relation to Smooth Running.

By Professor Joseph Torrey.

ELEVENTH PAPER.

Leaving the subject of the force exerted on the crank, as modified by inertia, for awhile, we will now give attention to force exerted at two other places, namely, the crosshead pin and the guides.

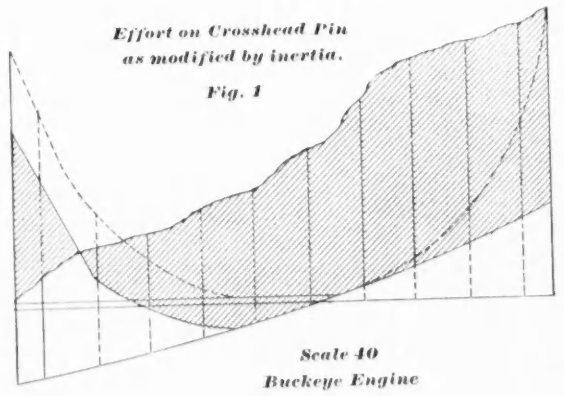
The force exerted at the crosshead pin is obviously less modified by inertia than that at the crank-pin, since the inertia of the piston, rod, and crosshead alone enter into the case. That is, before any effort can be felt at the crosshead pin, the inertia of the piston, its rod and the crosshead must be overcome. Hence, all that is necessary in order to plot out a diagram of actual effort realized on the crosshead pin, is to take the real diagram of steam pressures, as we did before, and proceed just as we did in case of the crank-pin, only taking the weight of the three first reciprocating parts into our calculation, instead of the total weight. The connecting rod in moderately fast engines often weighs about one-half what all the reciprocating parts together do, so that, in order to get an idea of the magnitude of the forces exerted on the crosshead pin, we may take as our "weight of reciprocating parts," about one-half the total. We do not have to go through any calculation, either, for we know that the inertia varies directly with the weight of the reciprocating parts. Therefore, if we have the diagram of effort on the crank-pin, we have only to lay off on each ordinate just half the inertia force obtained with the total weight, and this will be the inertia developed with half the total. For careful work, of course, the piston, rod and crosshead should be weighed. The diagram resulting from this process will resemble the one shown in Fig. 1, which is from the same Buckeye engine that Fig. 1 was taken, in the tenth paper. An inspection of the diagram will make it clear that, in all fast engines, the crosshead pin will always be subject to greater variations of pressure during the stroke than the crank-pin. Again, it will be noticed that, owing to its being nearer the cylinder, and less

Fig. 4

11″ x 20″ Porter Allen
Pressures on Guides

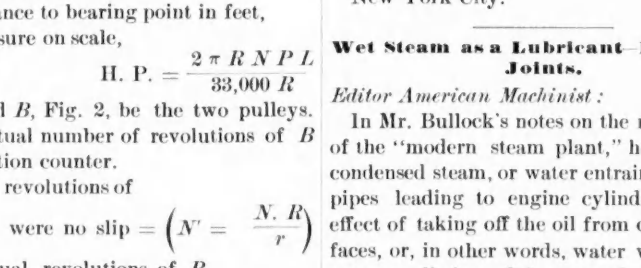
Effort on Crosshead Pin as modified by inertia.

Fig. 1



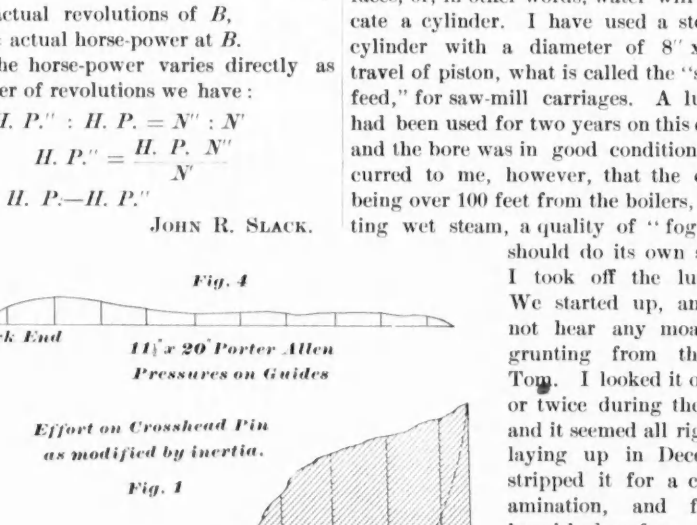
Scale 40
Buckeye Engine

Fig. 2



Effort on Crosshead Pin as modified by inertia.

Fig. 3



Scale 40
Porter Allen Engine

Force in the Steam Engine.

under the influence of inertia, it gets more of the benefit of compression. The strains and wear to which the crosshead pin is exposed, are obviously different in kind and amount from those at the crank-pin. In the former case, the wear is mostly due to shocks on the head and crank sides of the pin. There is, of course, not much wear due to rubbing. The result is, that the crosshead pin generally wears oval, unless care is taken to avoid this, by either providing overrunning surfaces, or arranging, as in the short-stroke straight-line engine, for occasionally turning the pin in its bearings, and thus maintaining a nearly cylindrical surface.

The main use of the diagram of effort on the crosshead pin, to us, however, is to give us insight into another set of forces developed by the crank. At the crosshead pin the force is split; part goes along the line of connecting rod to the crank-pin, and part is exerted on the guides as friction. At the ends of the stroke the force is exerted directly along the line of centers, and there is no downward pressure due to effort of strain and inertia, on the guides. At every other point, however, there is a certain amount of force exerted downward. This downward force varies in amount, according to the angle which the connecting rod makes with the guides. It can be found for each of 12 points in the stroke (including the beginning and end) by either of two methods. The first method depends on the mechanical principle of resolution of forces. For instance, referring to Fig. 2, suppose a certain force to act along the piston rod, evidently some force is exerted downward on the guides, and some along the line of the connecting rod. Now, how much in each case? To solve this problem, proceed as follows: Draw the circle $d\ b$, having a radius of 100 units ($1\frac{0\,0}{1\,6}''$, for instance,) with compasses or trammel points set to the length of the connecting rod (in this case 6 cranks); mark from a and c the points a' and c'; divide $a'\ c'$ into 10 equal parts, then subdivide, getting the points 1, 2, 3, 4, 5, etc. Setting the point of the compasses at 1, mark the arc at 1', and do the same for each of the other points. This gives us the crank positions for each of the piston positions 1, 2, etc. Draw from the point 1' a perpendicular to the line of centers $a\ a'$. Draw similar perpendiculars from the points 2', 3', etc. Now carefully measure the length of the perpendicular from 1' *in sixteenths*, divide this measurement by the length of connecting rod in sixteenths, and the result will be a decimal fraction, expressing the proportion of the total force which has a downward effect on the guides. For example, the perpendicular from 1' will measure $4\frac{1}{1\,6}$. This, divided by $\frac{6\,0\,0}{1\,6}$, that is, dividing 41 by 600, gives .0683, which means that at the piston position 1 about $\frac{6}{1\,0\,0}$ of the total force is exerted downward on the guides. This method is very accurate, if care is taken in construction and measurement. There is another way it can be done, and that is, to lay off the lines 1 1' 2 2', etc. (representing the center line of the connecting rod at each of the piston positions shown), measure the angle which the connecting rod makes with the line of centers in each case, and find the *sine* of this angle, by means of a table such as given in books on trigonometry and engineers' pocket-books. This does not, I think, give such good results as the graphic method given above. It is not an easy matter to measure such small angles accurately, and most of the protractors in common use are not exact. About as accurate a way to find the angles as any, is to get the forces on the guides as described first, and then notice that these forces are the same as the sines of the angles, which is the case. The angle corresponding to each sine can then be found by means of a table. The table given herewith shows the proportion of the total force transmitted which has a downward effect on the guides in an engine having a rod = 6 cranks. To use the table, multiply the forces at the points 1, 2, etc., as obtained from the diagram of effort on the crosshead pin by the numbers in the table. This will be illustrated later. It will, of course, be seen that, thus far, we have been dealing with an *over-running* engine. In case of an under-running engine the force would be exerted against the *upper* guide.

From the same figure we used in getting the forces on the guides, we can also get the forces which act directly along the connecting rod from crosshead pin to crank-pin. To do this, measure the lines 1 1' 2 2', etc., in sixteenths, and divide by the length of connecting rod. The result will be the force acting along the rod at each point.

TABLE SHOWING FORCES ON GUIDES.

	Ord.	C. Rod Angle.	Forces on Guides.
Front End — Back End	0	0°	0.000
	1	3° 55′	0.683
	2	6° 30′	0.113
	3	7° 56′	0.138
	4	8° 55′	0.155
	5	9° 27′	0.164
	6	9° 34′	0.166
	7	9° 20′	0.162
	8	8° 38′	0.150
	9	7° 11′	0.125
	10	4° 24′	0.0766
	0	0°	0.000

11½x20 PORTER-ALLEN 230 R. P. M.

	Ord.	Pressures on Cross-head Pin.	Pressures on Guides.
Back End — Front End	0	53 lbs.	0.00 lbs.
	1	51 "	3.84 "
	2	52 "	5.87 "
	3	38 "	5.24 "
	4	22 "	3.41 "
	5	15 "	2.46 "
	6	15 "	2.49 "
	7	14 "	2.26 "
	8	15 "	2.25 "
	9	18 "	2.25 "
	10	20 "	1.53 "
	11	2 "	0.00 "

Let us now proceed to find the pressures on the guides in case of an actual engine. Fig. 3 represents a diagram of effort on the crosshead pin of a Porter-Allen engine, 11½x20 at 230 R. P. M.

Taking the weight of the piston and rod and crosshead as our weight of reciprocating parts, we proceed just as in case of the regular inertia diagram. In this engine the weight of these parts was 168 lbs., and on figuring the inertia, and laying out the curve, it has the form $c\ d\ e$. Then we measure the forces represented by the ordinates 1, 2, 3, etc., which are the forces exerted on the crosshead pin. Then multiplying these forces by the numbers in the table, we obtain the results shown in the table; for instance, on ordinate 1 the pressure on the crosshead pin was 51 lbs. per sq. in. This, multiplied by .0683, gives 3.48 lbs. per sq. in. The process in each case would be the same.

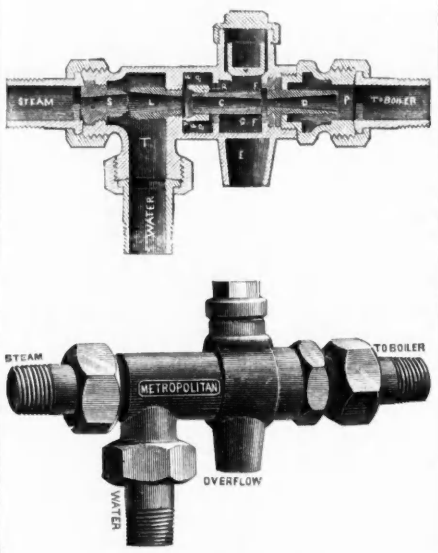
When these forces have been computed, it is a good plan to draw a curve, showing their amount and distribution, as this gives a very clear view of them. For this purpose, draw a straight line, and divide it as usual; then measure off to scale the proper force on each ordinate. Through the outer ends of the ordinates draw a curve as shown in Fig. 4.

In the next paper, tables will be given by which the forces on guides can be calculated for 5-crank and 7-crank connecting rods.

A curious lawsuit is now under way in Baltimore, Md. One dealer has sued another for ruining his business by underselling him, and he claims damages in the sum of $100,000. It is needless to say that machinery men can still continue to lower prices without danger of suit, unless it be from their creditors.

The Metropolitan Automatic Injector.

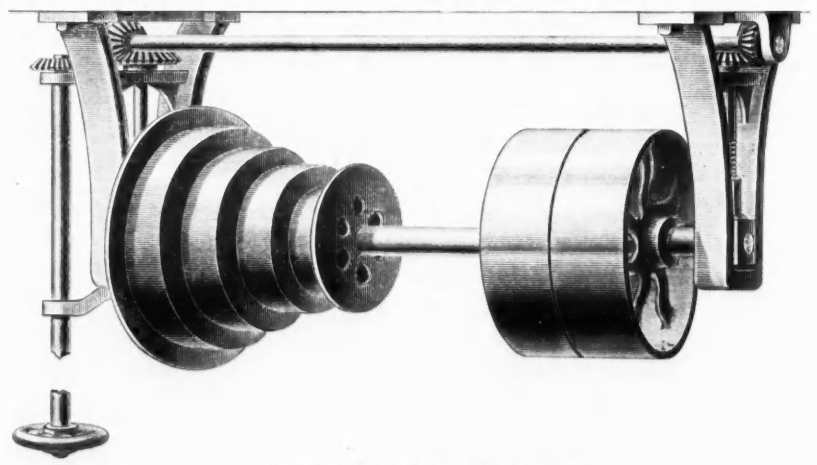
The illustrations represent an automatic injector, possessing features which render its operation exceedingly simple, and reduce the number of its working parts to a minimum. The injector, when in working order, should always stand in a horizontal position, the water entering at the bottom as shown. In our illustrations, the steam pipe is represented as connected to the injector at the left-hand side. For the purpose of regulating the steam supply, the steam pipe is provided with a globe valve (not shown) placed as near to the injector as possible. Another globe valve is placed in the suction pipe, and is used for regulating the flow of water. The delivery pipe at the right is provided with a check valve. It is a fact demonstrated by practice, that if we could remove the primary overflow valve of an injector after it is started—thereby forming a communication between the primary and secondary overflows—we could work water with from ten to fifteen units of heat more than if the overflows remain closed. The fact is also demonstrated, that if there is a direct communication between the primary and secondary overflows while starting an injector, it is found not to be automatic below seventy or eighty pounds.



AUTOMATIC INJECTOR.

The improvement of this injector lies in the fact that the communication between the primary and secondary overflows is momentarily automatically closed in starting the injector, then when once started is automatically opened, thereby forming a communication between the two overflows.

The steam enters the injector through the jet S, passes into the chamber G through the jet L, causing the auxiliary check R to slide towards the right along the tube C, and thus opening a full communication between the chamber G and the small chamber at its left-hand side, thereby enabling the steam to open the overflow valve V, and pass out freely through the overflow E. This rush of steam draws, in the meantime, air out of the chamber T, creating in it a partial vacuum, which allows the water to rise from a lower level. As soon as the water reaches the chamber T, the steam is condensed, and a velocity imparted to the water, which passes on into the chamber G; as the velocity increases, the water passes through the tube C, and spills through the opening $F\ F$, forcing the auxiliary check R back on the tube C; and when this auxiliary valve reaches the partition $Q\ Q$, thereby momentarily closing the communication between the primary and secondary overflows, the partial vacuum in the chamber at the left of G allows it to regain its original position shown in the illustration, thereby opening up this communication.



ADJUSTABLE COUNTERSHAFT.

As soon as the water attains a sufficient velocity to overcome the boiler pressure, the water passes on through the tube D, thereby forming a vacuum in chamber G, and causing the overflow valve V to close.

From this it will be seen that the construction is very simple. When an examination of the injector is necessary, it can be readily taken apart with an ordinary monkey-wrench and screw-driver.

To operate the injector it is only necessary to open fully the globe valve in the steam pipe, and also open the globe valve in the suction pipe. Should water appear at the overflow E, the globe valve in the suction pipe must be throttled until the discharge of water at the overflow ceases, which indicates that the water is then being forced into the boiler. After the globe valve in the suction pipe has once been set, it is not necessary to touch it again, and the injector can be stopped or started simply by opening or closing the globe valve in the steam pipe.

The injector can be started with 20 pounds of steam, and works up to 145 pounds without adjustment, and when desired can be made to work up to 200 pounds.

It is claimed that a hot suction pipe will not prevent the injector from starting readily. It is also claimed that severe jarring will not affect its working, as its automatic qualities will re-start it if the feed is for any cause temporarily stopped.

Two steam jets are furnished with each injector, so as to make it either lifting or non-lifting. When used as a non-lifter, will work from five pounds up.

This style of injector will work on any kind of boiler, but is more especially adapted for stationary, marine, portable and traction engines. Different sizes of these injectors are made, their capacities ranging from 40 to 3,480 gallons of water per hour. These capacities are based upon 65 pounds' steam pressure, and 4 feet lift.

This injector was invented and perfected by John Desmond, and is manufactured for Jenkins Brothers, 71 John street, N. Y., General Agents.

An Adjustable Countershaft.

Every machinist knows that it is best to keep driving belts just as loose as the nature of the work will admit, for by so doing the friction and wear upon the journals is much reduced, the life of the belt is very greatly increased, and it is much more easily handled and shifted from step to step of the cone pulleys when changing speed. Where only one thing is done upon a machine, it is, of course, possible to keep the belt about as loose as the work it has to do will permit; but in the case of a lathe, milling machine, or, in fact most machine tools upon which a variety of work is done, there are times when it is necessary to have the belt as tight as possible, and yet, perhaps, most of the time it could be quite loose.

We illustrate on this page an improved countershaft—gotten up by a machinist—to enable the belt to be instantly adjusted to the degree of tension necessary for the work in hand. The boxes are in one piece, provided with flanges to keep them in place, and are moved up or down in the hangers by means of screws which are turned by the gears and shaft passing over the countershaft, which in turn is moved by means of the vertical shaft, upon which is a hand-wheel placed within easy reach of the operator.

By the use of such a countershaft no greater tension need be upon the belt at any time than is absolutely necessary to make it pull the cut, and thereby, as every machinist will know, a great deal of destructive wear and tear upon belts, and machine, and countershaft journals may be avoided, besides effecting a saving of power, time (otherwise spent in lacing and unlacing belts,) and of patience. The inventor and patentee is Frank R. Hynes, 109 Ambrose street, Rochester, N. Y.

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NEW YORK, MAY 2, 1889.

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An Engineer's Examination.

Coming down town on the elevated railroad the other day, we sat next a man, a stranger, who presently pulled out of his pocket a marine engineer's license, and saying his eyes were not very good, asked us to read an endorsement which had been written across its face. This endorsement proved to be an extension of the license, allowing the bearer to serve as chief engineer on a vessel of about seventy-five per cent. greater tonnage than the original license allowed.

We got into conversation, and he proved to be in the employ of a company which owns a number of small boats used for freight traffic about the vicinity of New York harbor. As he was about to take charge of the engine on the largest of these boats, he was obliged to get his license extended, and was just returning from the office where this extension had been granted by the proper authorities.

Asked if he were not required to pass a pretty strict examination in order to secure such a license, he replied that the examination was indeed very strict, and that an applicant must know how to figure almost everything. Taking a blank book from his pocket, he showed us some computations of the power developed by engines, and some figures relating to safety valve areas, etc., all of which he said an applicant for a license must be thoroughly familiar with. Presently he turned to a table which had written over the top of it the words, "Weights of round iron." This, he explained, was a table giving the *tensile strength* of round iron, such as is used for stay-bolts and braces in boilers. This table had been written in with pencil, and gave the weight of a three-fourths round bar at .484 pounds per foot. Our friend informed us that this meant that a bar of that size would *bear a weight of* 484 *pounds per foot*.

Now, it is quite evident that, if this man had been asked any real questions whatever about these matters, he must have revealed to the examiners not only his absolute inability to make such calculations, but also his entire ignorance of the subject of the strength of materials. And if he had been asked these questions, what was the object of the asking? If it was necessary for the security of the lives and property entrusted to him that he should be familiar with such matters, and able to answer questions regarding them, why was he granted a license after he had shown his inability to answer them? And if, in order to fill the duties of his position, it was not necessary that he should know anything of such matters, where was the use in going through the form of such an examination, and making him think, as he evidently did, that he had answered the questions satisfactorily?

No one doubts that the chief engineer of a large steamer should be entirely familiar with all such matters; but whether or not it is essential that engineers in charge of small freight boats plying about a harbor should be familiar with them, is an open question. But it either is essential or it is not essential, and it appears to us that there should be a decision one way or the other, and examiners should be governed accordingly. In other words, it should be determined just what an engineer needs to know in order to fill his place with safety to himself and others, and then examinations should be so conducted as to show whether or not he possesses that knowledge, license being granted or withheld accordingly. If an engineer ought to know how to make all the computations relating to steam engineering before receiving a license, he should be required to prove before the examiners his ability to make them. But if it is not important that he should be able to do this, then an examination upon it only takes up time which might be spent in an examination upon matters which are essential, and which have some meaning in connection with the practical ability of the applicant, and his fitness to receive the license asked for.

It is not improbable that this man was good enough for the place he was to occupy, as such things go, but it is evident that the examination he had undergone had done very little to prove it.

The Boiler Manufacturers' Association.

Last week we gave considerable space to a notice of the organization of the American Boiler Manufacturers' Association. It is too early to predict the outcome of this action on the part of boiler manufacturers. They represent a very important element of the manufacturing interests of the country, and carry on a business which, more than most others, the entire public is interested in. Those with no direct interest in the matter still have a lively indirect interest in the integrity of the work of the boiler maker, above which they must sleep, and over and around which they must move. If the association of boiler manufacturers can and wil do something to make life and property more secure, they will deserve universal thanks. The loss of life from boiler explosions is something frightful in its frequency, and should be checked in some way. How much of this is due to the use of poor material and faulty methods of construction it is not easy to tell. That these have caused a good many disasters has been very clearly demonstrated. And if boiler manufacturers quite generally unite with the association, it will have the effect of turning attention not only directly to the construction of boilers, but indirectly to their management.

The association declared unequivocally in favor of the use of only the best obtainable material, and they find there will be no difficulty in getting exactly the material they—within reason—call for. They were most emphatically assured by plate makers that they had only to agree upon what they wanted, and the mills would produce it.

If the stamp of the association is adhered to, it will be known with reasonable certainty what stock it covers, and this will remove one point always in doubt in bidding on boiler contracts. It is hardly to be supposed that any reputable boiler manufacturer would not willingly pay much more than the yearly dues in the association, to be assured that he was not bidding for work in competition with some one who would use material inferior to that which he proposed to use.

There is another way in which the association can be the means of doing excellent work; that is, through committees, similar to those appointed by the Master Mechanics' Association, to inquire into the best practices of construction, fittings, etc., and to report at the regular meetings. Boiler making has in the past been looked upon as rather a crude art. If the association continues and prospers, it will very soon put this art in quite another light.

The association cannot yet be said to be fairly organized. The work done at Pittsburgh was of necessity done in haste; still it does not, so far appear, that much was done that it will be necessary to undo. But it is a big undertaking to get such an organization on a standing to accomplish what it ought to accomplish. A good deal of earnest work must be done, and time will be required in which to do it.

As was before said, the outcome cannot be predicted. That will depend mainly upon the favor with which the movement is received by boiler manufacturers, and upon the zeal of those already members.

There is ample room in which to work, and the start seems to be auspicious.

The rush of the "boomers" into the Oklahoma country suggests the rush of manufacturers to parts of the country where a large inducement—free fuel, for instance—is held out to them. There is little doubt that many who are leaving all to go to Oklahoma are leaving behind more comfortable homes than they will ever again possess. In many instances they have weighed only the assumed advantages, quite overlooking the disadvantages. There is reason to believe that some manufacturers do the same thing. Those things that are offered free are not likely, according to all precedent, to last. Fuel that costs nothing to-day will be sure to cost money in the future, and then the manufacturer may find himself without compensation for inconveniences he labors under.

When a business is well established in any locality, it is, we believe, more likely to be a mistake than otherwise to move it. This is not saying that a removal is never advisable, but that it is not generally so. A good many instances could be named where manufacturers have moved in haste, either to regret and remain or to move back at their leisure.

Literary Notes.

HOT-WATER HEATING AND FITTING; or Warming Buildings by Hot-Water. A description of Modern Hot-Water Heating Apparatus; the Methods of their Construction and the Principles Involved. With many Illustrations, Diagrams and Tables. By William J. Baldwin, M. Am. Soc. C. E., Member American Society Mechanical Engineers. Author of "Steam-Heating for Buildings," etc., etc.

In this work the author gives the reader the benefit of a long and varied practical experience in warming buildings by hot-water circulation. Starting out with the knowledge that there is but little available in book form on this subject, he has evidently had in view the giving of as complete information as is practicable. And he does this in language that will be understood by the mechanic of ordinary ability, avoiding the use of methods that would be understood by the educated engineer only.

The work is very completely illustrated, and of the more than thirty chapters of which it consists, there is not one in which the reader will not find matters of interest.

The foundation of the book is a series of articles contributed by the author to *The Engineering and Building Record*, under the signature of "Thermus." The matter as thus contributed has, however, been thoroughly revised, and new matter has been added, making a large volume of nearly four hundred pages, conveniently indexed.

The book is published by *The Engineering and Building Record*, 277 Pearl street, New York; price $4.00.

Questions and Answers

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(190) J. S., New York, asks: Please give me the methods for determining the horse-power of engines and boilers? *A.*—For computing the horse-power of an engine, see answer to Question 305, in our issue of June 23, 1888. For estimating the horse-power of a boiler, see answer to Question 189, in our issue of April 25, 1889.

(191) G. C., Waterbury, Conn., writes: Please state just what is generally understood by "a good tool maker?" *A.*—We think that what is generally understood by the term is a man who can make a first-class tool of any kind, doing all the work upon it, from the rough forgings or castings to the finished tool.

(192) W. W. E., Mobile, Ala., writes: I want to force water through a pipe 1½ inch diameter over a distance of one-half mile; the rise is 125 feet. What size pump and what power is required to perform the work? *A.*—State the quantity of water to be discharged in any given time; we will then answer your question.

(193) E. C. H., Woodstown, N. J., says he has had trouble with an iron pattern for a gear wheel, and asks how to finish such a pattern. *A.*—File it smooth, looking out for the proper draft at all points. Then rust it thoroughly all over by repeatedly wetting it, after which heat it sufficiently to melt beeswax upon it. Apply the beeswax all over and rub smooth.

(194) H. C. P., Central Falls, R. I., writes: Please tell me how fast it is wise to cool a pot of steel that has had 48 hours for annealing, and how hot is it wise to allow the steel to be when dumped? *A.*—In the first place, it should not be heated for 48 hours to anneal, nor in fact any longer than necessary to heat it uniformly through to the required degree. After that, the slower it cools the better, within reasonable and practicable limits, though the actual time taken in cooling will depend much upon the size of the pieces. It should be nearly or quite cold when dumped.

(195) J. K. H., Cleveland, Ohio, asks: What is the horse-power of an engine 1⅞x2 inches, 60 pounds' boiler pressure, and making 300 revolutions per minute? *A.*—About ¼ I. H. P. 2. What size boat will this engine drive, and what will be the speed of the boat? *A.*—Boat about 10 feet long, 40 inches wide, 18 inches draft; speed about 4 miles per hour. 3. What will be the size of a vertical boiler for this engine? *A.*—Grate surface, about 60 square inches; heating surface, about 3½ to 4 square feet.

(196) W. H. M., Tamaqua, Pa., asks: Wh'ch car will curve the easier, a long car or a short one? *A.*—If both cars have the same kind of trucks, the short car will curve easier than the longer one. It often happens that the trucks under short cars are of a different design, and therefore it may be possible that the short car will not curve as easily and safely as the longer one. In fact, the same result may occur with trucks of similar design if they are not properly constructed for the work they have to do.

(197) A. M. H., New York city, writes: I have a large quantity of small iron forgings to manufacture, about 1½ inch square, having a fin about 1-16 inch thick around four sides after forging, which is punched off cold to complete. The cold punching leaves that part bright, and this is undesirable. I would like to make them appear same as coming from the smith without annealing or using paint. Would you please advise me what to do to obtain such result? *A.*—We think your best plan would be to have the trimming press close to the drop hammer, and trim off the fin while hot.

(198) F. M. G., Defiance, Ohio, asks: 1. What use are the vacuum pots on a Corliss engine; and why would not a steel spring answer the same purpose? *A.*—The vacuum dash-pots are used for closing the valves as soon as they are released from the valve gear; the dash-pots also give the necessary amount of cushioning, so as to prevent jerks at the end of the valve's travel. The smoothness of motion, close adjustment obtainable with a dash-pot, we believe cannot be obtained with springs. 2. What are air pumps used for on condensing engines? *A.*—Air pumps are used for the purpose of drawing out of the cylinder the water due to condensed steam, and the steam which has done its duty; form as near as possible a vacuum on the exhausting side of the piston, thereby removing as much as possible all opposing pressures (including the atmospheric pressure) to the steam which at that time is performing work. 3. Are air pumps used with jet condensers? *A.*—Yes. 4. What would be the horse-power of an engine 14x36, boiler pressure 80 pounds; cut-off at ¼ stroke, and making 80 revolutions per minute? *A.*—About 90 I. H. P.

(199) A. A. A., Hanson, Mass., writes: A stand pipe 25 feet diameter and 75 feet high stands on a hill 110 feet above the village. What is the pressure per square inch at the bottom of the stand pipe, and also at the village 2½ miles away? Please give rule. *A.*—The pressure per square inch at the bottom of the stand pipe is equal to the weight of a column of water 1 inch square and 75 feet high. A column of water 1 foot high and 1 inch square will weigh .434 pounds. Hence, to find the pressure we have the following rule: Multiply the height of the column in feet by .434, the product will be the pressure per square inch at the bottom of the stand pipe. Thus, the height of the stand pipe is 75 feet; hence, the pressure at the bottom will be

$$75 \times .434 = 32.55 \text{ pounds}$$

per square inch. So long as the water is not in motion, the pressure per square inch at the village will be equal to the weight of a column of water 75+110 feet high and 1 inch square. To find the pressure, we again apply the foregoing rule and obtain

$$185 \times .434 = 80.29 \text{ pounds'}$$

pressure per square inch at the village. When the water is in motion, this pressure will be reduced by the friction of the water in the pipes, and will depend on the size and kind of pipes used.

(200) P. E., Bridgeport, Conn., writes: We have an engine 9x18 inches, making 120 revolutions per minute; average pressure, 65 pounds; Judson's governor; piston valves; travel, 2½ inches; ports, ¾ inch; steam lap, ¾ inch; inside lap, none; takes steam at ends; exhaust cannot be choked at center. Now I would like to get along without using more steam. Would it be an improvement to increase the travel of the valve to 3 inches? Or, would anything be gained by decreasing the outside lap and giving the valve some inside lap? Would it pay to change Judson's for a high-speed governor? The engine is subject to heavy strains from starting of planer, or other heavy machinery, and does not recover quickly. When I say, "Will it pay," I mean will it make a difference in the coal bill, as about one-third of our fuel is coal. The valve, as it is now, cuts off at 10½ inches; exhaust opens at 16 inches, being full open at 18 inches; in fact, the exhaust edge of the valve travels beyond the steam ports. *A.*—If the smallest cross-section of the steam port is 5 inches long, you will have ample opening for the steam to enter into the cylinder, and nothing will be gained, excepting a more decided cut-off, by increasing the travel of the valve. In order to gain a greater economy in fuel, we should advise you to increase the boiler pressure, provided the boiler is strong enough; increase the outside lap so as to cut off at about 8 or 9 inches. Also, give the valve about 1-16 inch inside lap. An increase of outside lap will also require an increase of travel of valve. As to the governor, we do not see any reason for changing it. If it does not act satisfactorily, write to the makers; they will no doubt be willing to make such changes as to enable it to act as promptly as you may desire, or as any other governor will do.

(201) "Inquirer," asks: Will you please explain why the thickness of a belt should be considered in getting at the velocities of pulleys? I cannot see why a pulley 24 inches diameter will not drive a 12-inch pulley twice as many revolutions as it makes itself. I should think the ratio would be 2 to 1; but by the law governing levers it would be 1.96 to 1. *A.*—We don't know just what you mean by this last expression about levers, but the reason the thickness of the belt must be taken into account is because the different portions of it do not travel at the same speed when going around the pulleys. When a belt is bent, the inner portions of it are compressed, while the outer portions are stretched. This is the action which takes place in bending a belt over a pulley, and it is evident that the actual speed of the belt should be taken at the neutral point, or that point in its thickness at which neither compression nor extension takes place; for on either side of this line the actual velocity differs from the average velocity. To explain it another way: If a belt is laid out straight upon the floor, its two surfaces are of equal length, and, when moved along in a straight line, will travel at the same velocity. Practically, this condition obtains when the belt is traveling between two pulleys. But in passing over a pulley, the outside of the belt must travel in an arc the radius of which is greater than the radius of the pulley by an amount equal to the thickness of the belt. It must consequently pass through a greater distance than the inside of the belt passes through in the same time. But between the two surfaces of the belt there will be a point which will move at the same speed as the belt moves in passing from one pulley to the other, and this is the average normal speed of the belt, from which the calculations should be made. This point is thought to be, under ordinary conditions, about ⅛ of the thickness from the inside of the belt, though it is common to assume it to be at the middle when making calculations, as it makes them a little more simple, and is sufficiently accurate for most purposes.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue

Gear wheels and g-cutting. Grant, see adv., p. 16.

Link-Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N. Y.

20″ Upright Drills. J. E. Snyder, Worcester, Mass.
23″ Upright Drills. J. E. Snyder, Worcester, Mass.
25″ Upright Drills. J. E. Snyder, Worcester, Mass.
28″ Upright Drills. J. E. Snyder, Worcester, Mass.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Special tool work. R. M. Clough, Meriden, Conn.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Berryman Feed-Water Heater and Purifier. Benj. F. Kelley, 91 Liberty street, New York.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

Fire Brick and Clay Retorts for all kinds of heating and melting furnaces. Borgner & O'Brien, Phila.

Ice and Refrigerating Machines, 131 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

"How to Keep Boilers Clean." A 96-page book mailed free by Jas. E. Hotchkiss, 120 Liberty st., N. Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Best silk wiping towels for machinery in the market. S. A. Smith, 23 S. Canal st., Chicago, Ill.

Iron Planers from 16″ to 36″ wide by any length. H. C. Pease & Co., Worcester, Mass.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Send $1 for Catalogue D. Fine Tools and Supplies. Over 550 pages. Fully illustrated. Frasse & Co., 92 Park Row, New York

All sizes of Taps & Dies from 5-64 of an inch to 4 inches ▼, U. S. S., Whitworth, Square & Left-Hand Threads. M'f'd by S. W. Card & Co., Mansfield, Mass.

Split Pulleys at low prices and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

See Illustration of Portable Key-Seating Machine in April 4 issue. For further particulars address T. C. Dill Mach. Co., 726 Girard av., Philadelphia, Pa.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See April 4, p. 10. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Fine tools and supplies for machinists and other metalworkers. Get our prices before purchasing elsewhere. Montgomery & Co., 105 Fulton st., N. Y. City.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches, working drawings for the transmission of power by steam, water, air and electricity.

Steam Boilers: Their management and working on land and sea. By Jas. Peattie. Practical facts from 30 years' experience. 230 pages illustrated, 12mo., cloth, $2.00. Circulars and Catalogue of Books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N. Y.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing grey iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N. Y.

The International Boiler Co., Limited (Allan Stirling, M. E., president,) manufacture the safest, most economical, compact and durable water tube boilers. All wrought metal. Large mud drum. Perfect circulation. By unscrewing only three bolts, access is gained to every part of the boiler. Dry steam and great economy of fuel guaranteed. Office, 74 Cortlandt street, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

"Practical Drawing." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including April 25, 1889 issue, 75 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 89 articles have thus far appeared up to and including the April 18, 1889 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

MANUFACTURES

A. Reynolds & Son will rebuild their machine shop at Macon, Ga.

Brown Bros. expect to build a wood pulp paper mill at Little Falls, Maine.

The La Grange (Ga.) Cotton Mills will build a machine shop and foundry.

Lynch Bros.' boiler works, at North Kokomo, Ind., were recently destroyed by fire.

The Baldwin Locomotive Works lately shipped ten locomotives to Buenos Ayres.

The Reliance Lumber Co., Beaumont, Texas, has increased its capital stock to $500,000.

The Birmingham (Ala.) Foundry and Machine Co. is contemplating extensive improvements.

The Empire Lumber Company, Winona, Minn., is building a two-story sash, door and blind factory, 64x90.

The Watertown Machine Company has been incorporated at Watertown, Wis.; capital stock $60,000.

The Baltimore & Ohio Railroad Co. are building car and repair shops at Grafton, W. Va., to employ 200 men.

The Florence Railroad and Improvement Co. is interested in building a furniture factory at Florence, Ala.

E. M. Hodges will build a machine shop and foundry at Kinston, N. C. The machine shop will be 25x100 feet.

Strong & McBride will build a shingle mill on the site of the Shippey shingle mill, Muskegon, Mich., which was burned last year.

The Burns Copper Welding Company has been organized at Pittsburgh, Pa., to control the process of welding copper invented by James Burns.

The Southern Electric Co. has been organized at Baltimore, Md. It purposes to build electrical machinery, erect lighting plants, etc.

The United States Gas Light Company, of Philadelphia, Pa., has purchased the plant of the Atlanta Gas Company, Atlanta, Ga., and will enlarge it.

The Cannon (N. C.) Manufacturing Co. will erect another cotton mill and double its capacity. Their present factory has 160 looms and 4,260 spindles.

The North Alabama Lumber and Wood-working Company, Fort Payne, Ala., will build a saw-mill of 15,000 feet daily capacity, and a wood-working factory.

Work is progressing on the enlargement of the St. Louis (Mo.) Iron and Steel Works. When completed, the company will have an extensive foundry and machine shop.

The Penn Bridge Works, at Beaver Falls, after an idleness of several weeks—the result of a lack of orders, will start up in full this week, having secured a number of large contracts.

J. & D. Noble, Anniston, Ala., will build new boiler shops, their business having outgrown their present quarters. They have bought 2½ acres of ground in addition to that they now occupy.

There was recently built at the works of the Marion Steam Shovel Co., Marion, Ohio, what is believed to be the strongest railroad wrecker so far built in this country. It is guaranteed to lift 50 tons.

There is a prospect at McKeesport, Pa., for building a blast furnace. A company with $1,000,000 capital is organized, with E. C. Converse, assistant general manager of the National Tube Works, at the head. There will also be built a large number of coke ovens. The entire output of the blast furnace will be consumed by the tube works.

Cameron & Sons' new shingle mill, Mobile, Ala., will be larger than the one burned, cutting from 400,000 to 500,000 daily, with the necessary kilns. A mill will also be built for manufacturing cypress strips.

The Sheldon Axle Works, at Wilkesbarre, Pa., which has the largest axle plant in the country, are increasing their force of workmen as fast as room and facilities can be had. The company has orders six months ahead.

Merriam & Co., Syracuse, N. Y., will continue the business of the insolvent firm of Leeret, Blaisdel & Co., including the manufacture of sash, doors and blinds, cigar and packing boxes, interior finish, etc., employing 100 men.

The Nashville (Tenn.) Well Works and Tool Co will establish a factory to employ 250 men for the manufacture of wind-mills, well tools, etc. Six factory buildings will be erected, the largest being 150x50 feet, and the engine and boiler house 40x30 feet.

The stockholders of the Arms, Bell & Co. nut and bolt works, of Youngstown, Ohio, destroyed by fire recently, have decided to rebuild as soon as their insurance is adjusted. An entire new line of the most improved machinery will be placed in the plant.

W. H. Young, of Kenton, O., A. W. Butt, Springfield, O., and others have organized a company with a capital of $150,000, at Asheville, N. C., to purchase, enlarge and operate the plant of the Tuckasegee Lumber and Manufacturing Company, and Avery & Irwin's furniture factory.

The G. H. Toadvine Lumber Company, formed at Salisbury, Md., is building a saw mill and dry kilns at Elizabeth City, N. C., on the Pasquatanx River and Norfolk & Southern Road. The sawing capacity will be from 25,000 to 30,000 feet daily. A planing mill will be built on an adjacent timber tract.

The Nashua Manufacturing Co., Nashua, N. H., are having a third story, 367x40 feet, built on one of their mills. A temporary roof has been put on the second story while the walls and roof are being put on, and all the machinery in the mill is running. Additions of 175x22 feet, five stories high, will be made to the mill located on the river bank.

The New York Hydraulic Supply Power Co., 25 John st., New York, of which J. M. Dobson is the projector, proposes to lay mains and distribute hydraulic power on a plan something like that in successful operation in England. Mr. Dobson, who has given the subject much attention, believes New York City to be so situated as to be especially benefited by the introduction of hydraulic power.

There is water-works agitation at Greenville, Ala.; Jacksonville, Ala.; Sheffield, Ala.; Hickory, N. C.; Greenville, S. C.; Newbern, Tenn.; Waco, Tex.; Hampton, Va.; Harrodsburg, Ky.; Richfield, Kan.; Galena, Kan.; Somerville, Mass.; Spring Valley, N. Y.; Holyoke, Col.; Sidney, N. Y.; Tarrytown, N. Y.; Andover, Mass.; Newton, Mass.; Grant, Neb.; Red Bank, N. J.; Centralia, W. T.; Webb City, Mo.; Elberton, Ga.

Barnes, Wood & Co. have purchased some 25 acres of land east of the Grand Trunk Railroad and north of the Central Vermont at Rouse's Point, N. Y., for a site on which to establish a plant for a lumber planing mill and box manufactory. This establishment will have the advantage of a direct access to shipping facilities with cars on the Delaware and Hudson, Central Vermont, Ogdensburg and Lake Champlain, Canada Atlantic, and Grand Trunk Railroads and boats on Lake Champlain.

An application has been made for a charter for a corporation to be known as the "Mifflin Township Water-Works Company." The reservoirs will be located on the heights opposite McKeesport, Pa., and the water from them will be available for Dravosburg, Camden, Duquesne and Homestead. Also a good building territory above the villages not yet utilized. The same company will also apply for charters to erect water-works at Mansfield and Chartiers boroughs. The temporary directors are A. H. Logan, W. F. Wallace, O. R. Cooke, W. P. Logan and R. T. Hunter.

The P. C. Holmes Company has been organized in Gardiner [Maine] with a capital of $300,000, divided into shares of a par value of $100. The officers of the new corporation are as follows: President, George M. Holmes; Treasurer, S. N. Maxey; Directors, George M. Holmes, P. H. Holmes, George H. Holmes and S. N. Maxey, of Gardiner, and E. T. Gile and N. I. Jordan, of Auburn. On May 1st the P. C. Holmes Company is to succeed to the business of P. C. Holmes & Co., the well-known machinists. In 1831 P. C. Holmes came to Gardiner, and, in partnership with C. A. Robbins, established a machine shop, business being done under the name of Holmes & Robbins. In 1861 Mr. Holmes bought out his partner, Mr. Robbins. George M. Holmes and Thomas Wrenn became associated with the business at that time, the firm name being P. C. Holmes & Co. In 1874 P. H. Holmes was admitted to the firm, and in 1883 G. H. Holmes also. Mr. Wrenn died in 1866, and seven years ago, in 1882, P. C. Holmes, the founder of the business, passed away. The firm long since attained a high reputation for their water wheels, gears, etc., and because of the steadily expanding business, have for some time past been unable to keep up with their orders. Believing that the outlook warranted a considerable enlargement of their plant, a stock company has been organized, as stated above. P. C. Holmes & Co. employ now from thirty-five to forty hands, and the expansion contemplated will result in increasing their force very largely. Work on a new foundry will at once be commenced, and later the machine shop will be materially enlarged.—*Industrial Journal.*

Machinists' Supplies and Iron.

NEW YORK, April 27, 1889.

Iron—American Pig.—The use of Southern iron is increasing, and causes some feeling of uncertainty as to the future, which is reflected in the condition of the market, though the quoted prices rule about the same. We quote No. 1 X Foundry, $17 to $18; No. 2, $16 to $17; Grey Forge, $15 to $15.50.

Scotch Pig.—Prices have risen at Glasgow, but sales have been slow. We quote Coltness, $21.50 to $21.75; Gartsherrie, $20; Summerlee, $21 to $21.50; Eglinton, $19 to $19.25; Dalmellington, $19.75 to $20; Clyde, $20.50; Langloan, $20.50.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Mechanical engineer wishes opportunity to travel for manufacturer. Salesman, AMERICAN MACHINIST.

Wanted—Position as supt. or assistant by thorough machinist and draftsman. Irons, AM. MACH.

Wanted—Six good machinists who are accustomed to jobbing work. I. B. Coleman, Elmira, N. Y.

Wanted—A position as mech. draftsman; good practical exp., marine or stationary. C., AM. MACH.

Wanted—A first-class lathe hand with $1,000. A good salary will be paid to a first-class man. Address BOX 90, AMERICAN MACHINIST.

Wanted—Good man on steel rules; must be experienced and thoroughly competent. Address Box 84, AMERICAN MACHINIST.

Wanted—A first-class moulder, competent to superintend a foundry. Must have $5,000; a good salary will be paid to a first-class man. Address BOX 78, AMERICAN MACHINIST.

Wanted—A first-class machinist with $5,000 to $10,000 cash in an old and well-established manufacturing business. Address P. O. Box 104, Baltimore, Md., giving reference, age and experience.

Wanted—Superintendent to take charge of a wood-working machinery manufactory; must be versed in designing, pattern making, and understand the handling of men. Address Indiana Machine Works, Fort Wayne, Ind.

Machinist with good technical education, 13 years' exp. in building tools, pumps, marine, stationary and locomotive engines, in charge of machine department at one of the largest iron furnaces South; wants situation, energetic, best references. A. J. S., 344 W. 14th street, New York.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent steel tube scrapers are unquestionably the best. Crescent Mfg. Co., Cleveland, O.

Crescent boiler tube cutter, for setting new and removing old tubes. Crescent Mfg. Co., Cleveland, O.

Steel Name Stamps, Copper Burning Brands, etc. W. G. Sackmann, 1099 First av., Cleveland, Ohio.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

August C. Christensen, 24 State st., N. Y., Consulting Engineer. Designs of all kinds of Machinery.

Turned and Highly Polished Iron and Steel Shafting a specialty. Merwin McKaig, Cumberland, Md.

Parties wishing to exchange their old gear cutters for full automatic machines, address, giving description, "Trade," AMERICAN MACHINIST.

For sale, cheap, 32-inch Prentice Bros. Back-Geared Power Feed Drill Press, new. Price, $250. Address Standard M'f'g Co., Moore's Hill, Ind.

Engineers wanted to send their addresses and receive free a 25 cent book, "Hints and Suggestions for Steam Users." Thos. Ordish, 1723 S. 7th st., Phila., Pa

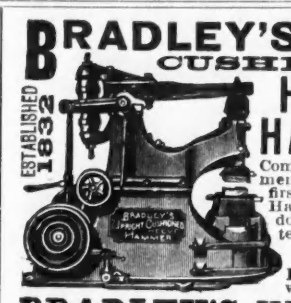
Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Machine wanted for upsetting or compressing by hydraulic or other means, bars of iron or steel for eye-bars, having a sectional area of 3 to 10 square inches. Address "M. G.," care P. Everitt, 293 Broadway, New York.

For Sale—Mfg. and jobbing machine business, established over 5 years. All modern tools in best of shape; easily work six hands; will bear investigating; $300 worth of work now ready if taken at once; satisfactory reason for selling. Price, $3,000. H. P. Norton, Brockton, Mass.

Wanted—To correspond with a reliable, trustworthy man (machinist preferred), who desires to start business for himself, who would like to buy or lease, on easy terms, a half interest or the whole of a small foundry, machine shop, wood shop and grist mill in Virginia, favorably located on navigable river, within 100 yards of wharf. For further particulars address at once, C. A. Hege, Salem, N. C.


BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

ESTABLISHED 1832

Combines the best elements essential in a first-class **Hammer.** Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the world.

BRADLEY'S HEATING FORGES.

ESTABLISHED 1832

With a manufacturing experience of over half a century, we recommend these machines to be the best, simplest, most durable and combining all the essential elements. **For hard coal or coke.** Indispensable in all shops to keep Bradley's Cushioned Hammers and men fully employed and reduces cost of production.

Pat. Aug. 30, 1887.

BRADLEY & CO.
SYRACUSE, N. Y.

98 Sudbury St., Boston, Mass.
63 Murray St., New York.

SOLID EMERY OIL STONES AND Triple Coated KNIFE SHARPENER

WHOLESALE ONLY BY THE TANITE CO., STROUDSBURG PA.

MONTGOMERY & CO.,
105 FULTON ST., NEW YORK,
TOOLS, SUPPLIES AND MACHINERY
FOR ALL BRANCHES OF THE MECHANICAL TRADES.
Illustrated Catalogue (300 pages) mailed on receipt of Fourteen Cents.

PATENTS.
During **April** and **May** my fees due only on allowance if desired. Write
WM. H. BABCOCK,
513 Seventh St., Washington, D. C., P. O. Box 220.
Formerly Examiner in Patent Office.
THIRTEEN YEARS' PRACTICE.

TO MACHINE MANUFACTURERS.
The subscriber has an article of sterling merit, for which a large market is waiting, and wishes to arrange with parties having capital and desiring to increase their business, or parties who would like to establish a new business, to manufacture and sell. Fully protected by a number of valuable patents. Would take an interest in the business as part payment for the patents, or would sell them outright if desired.
Address W. G., Box 2685, Boston, Mass.

SOLDERING Iron and Steel may be done without causing RUST
by using our **Non-Corrosive** Soldering Fluid.
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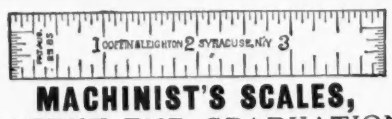
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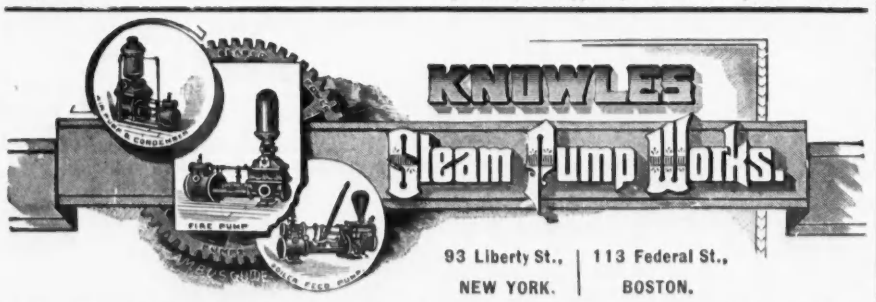

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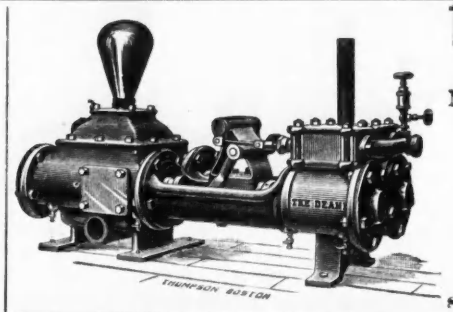
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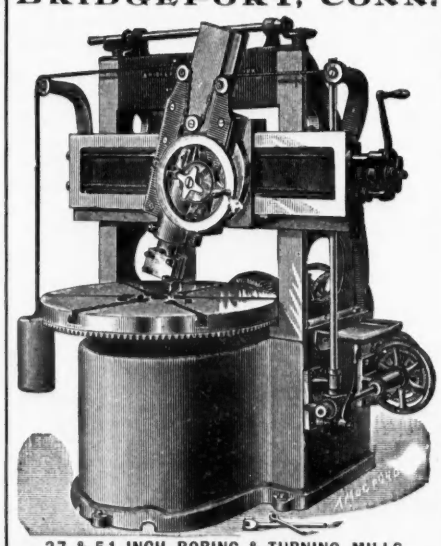
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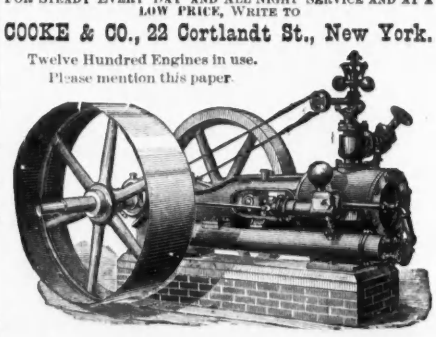

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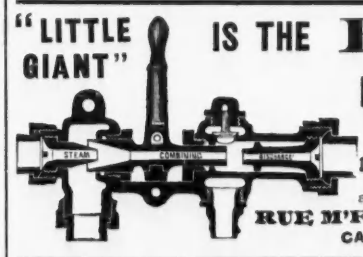
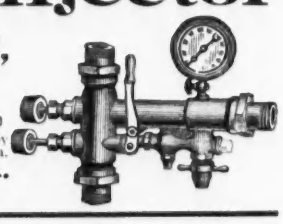

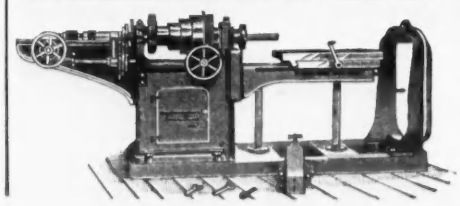
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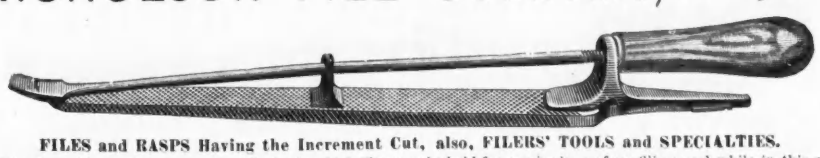

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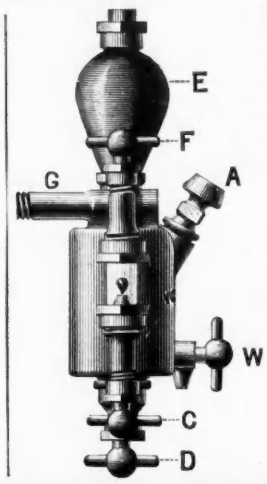

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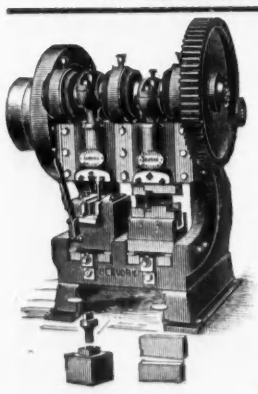

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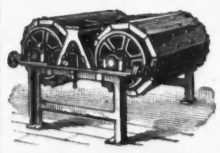

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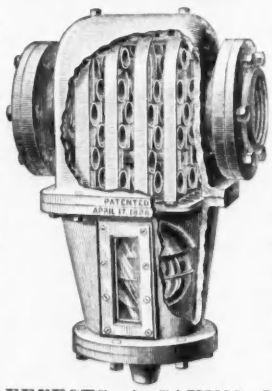

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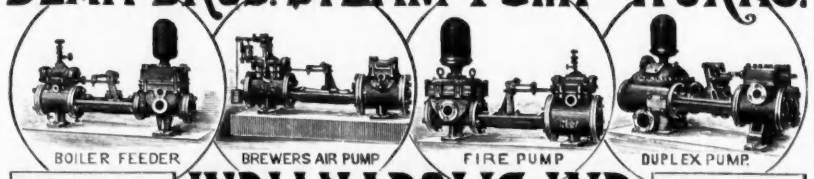

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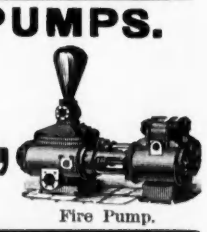

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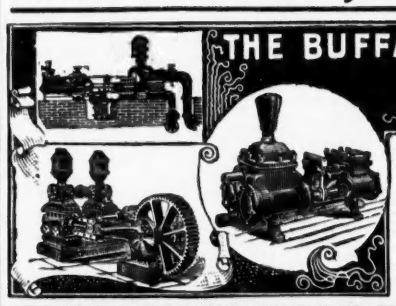

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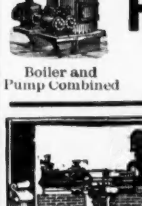

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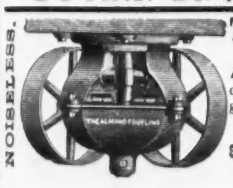

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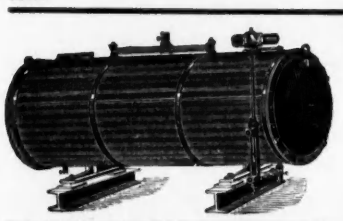

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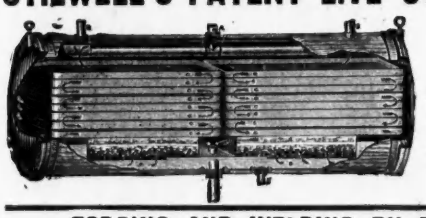

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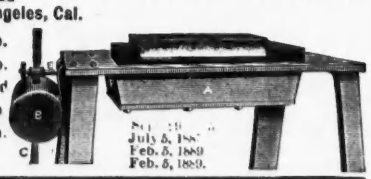

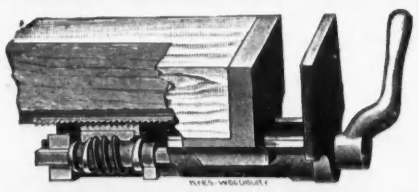

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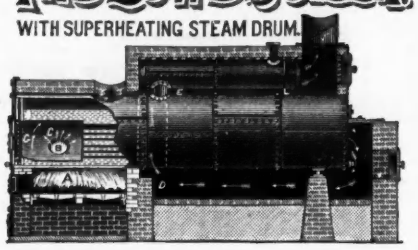

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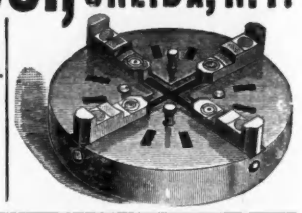

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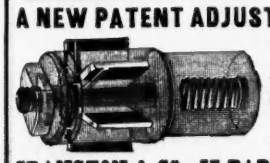

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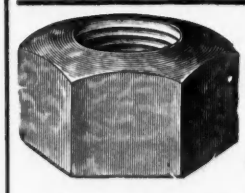

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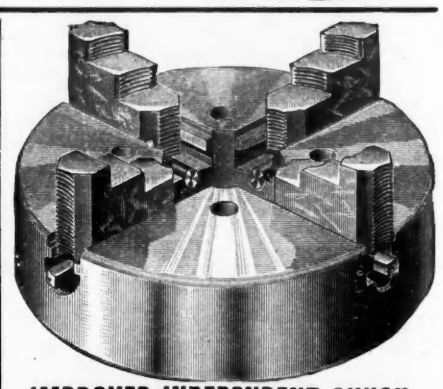

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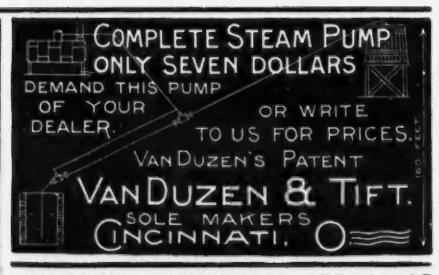

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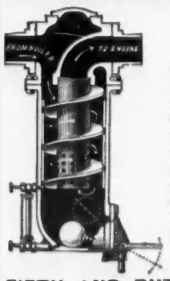

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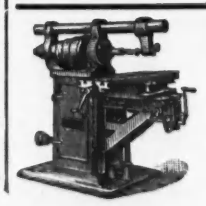

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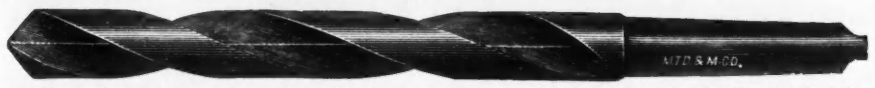

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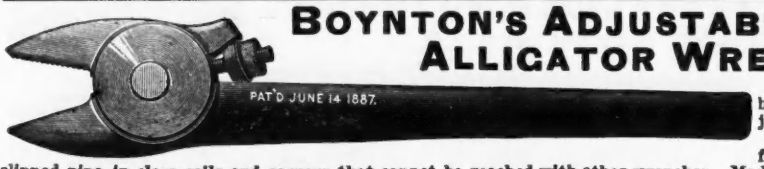

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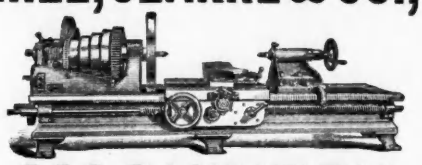

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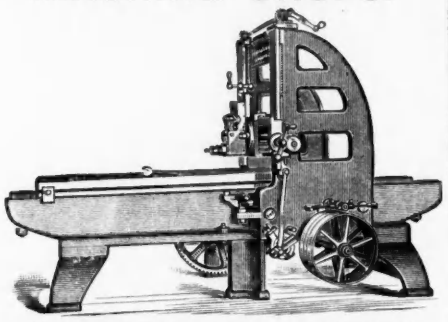

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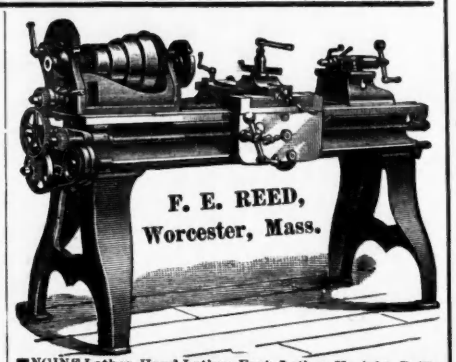

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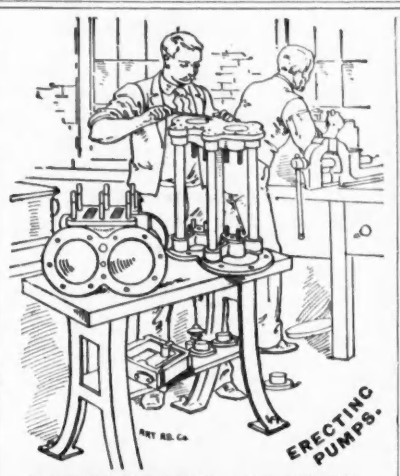

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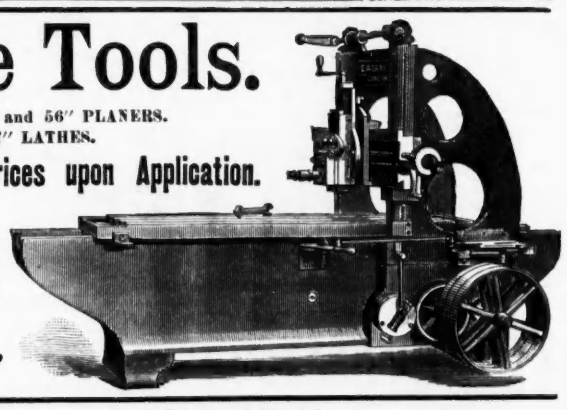

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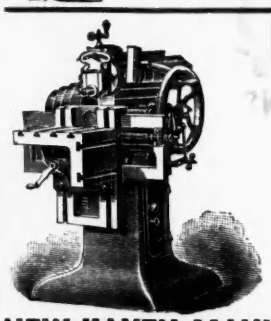

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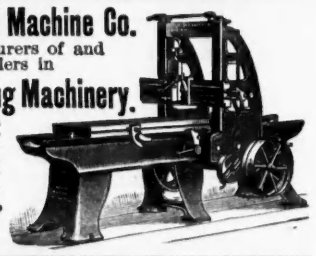

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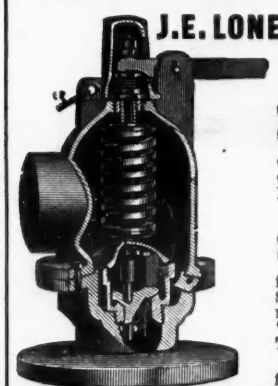

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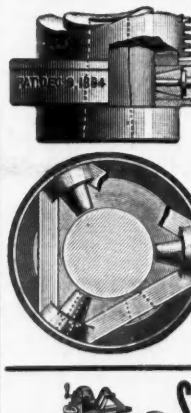

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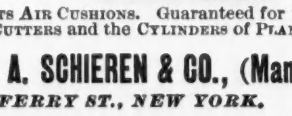

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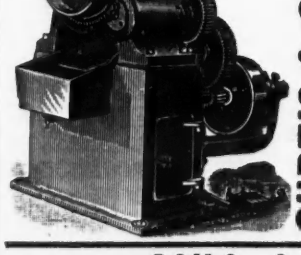

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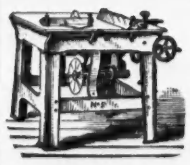

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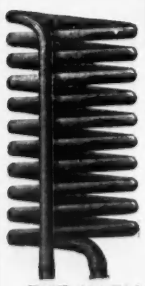

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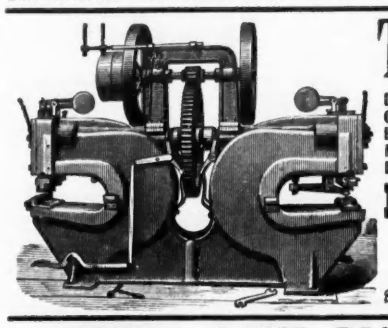

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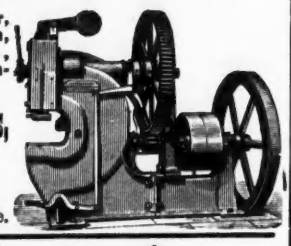

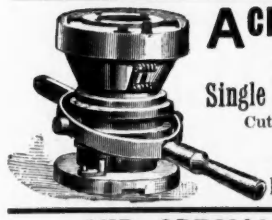

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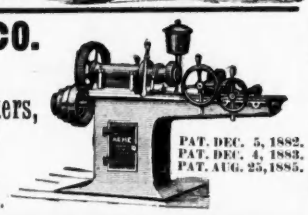

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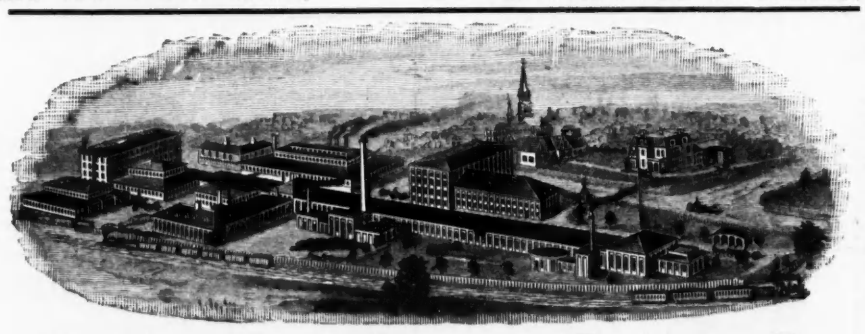

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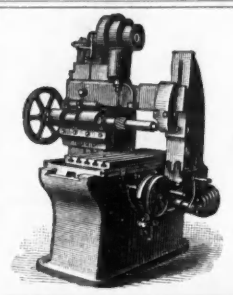

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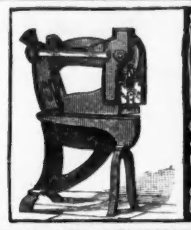

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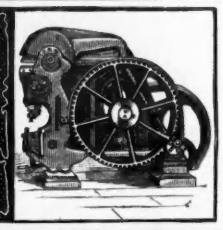

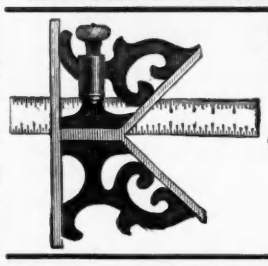

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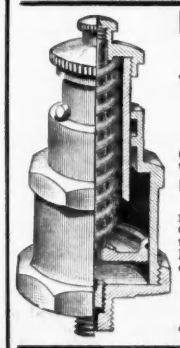

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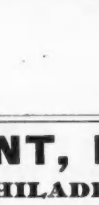

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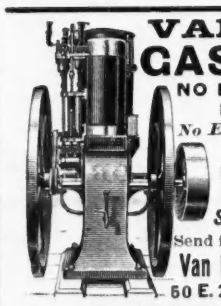

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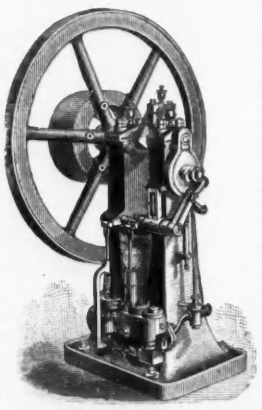

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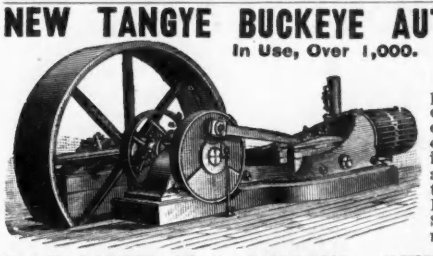

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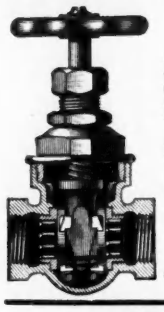

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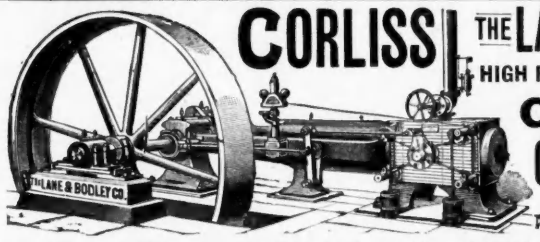

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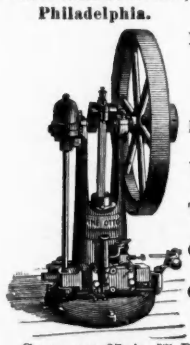

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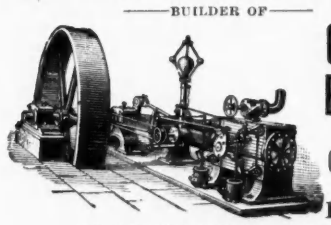

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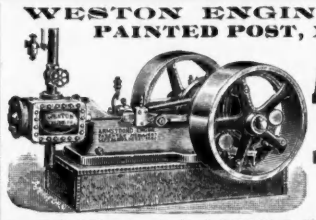

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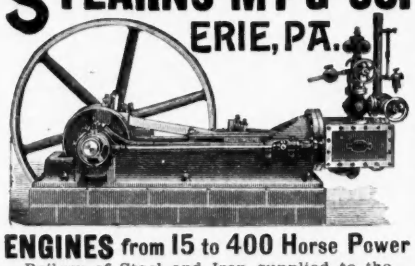

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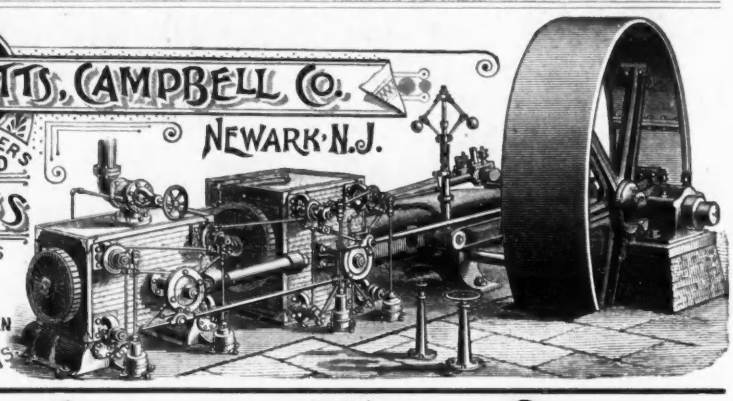

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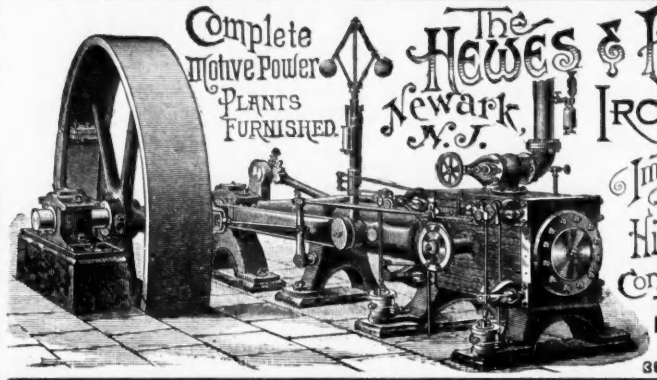

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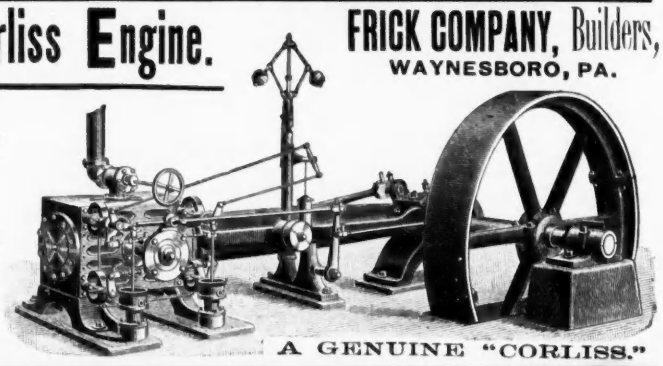

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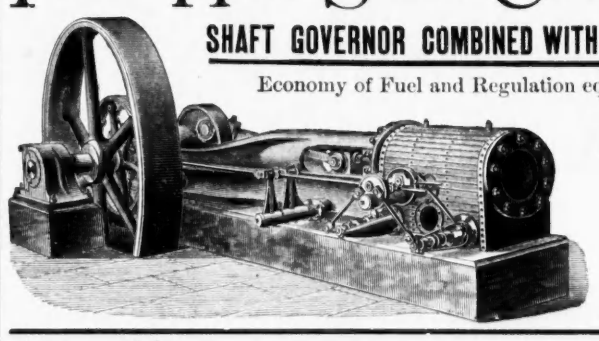

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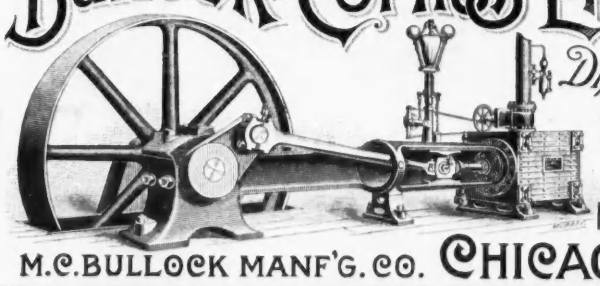

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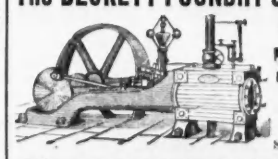

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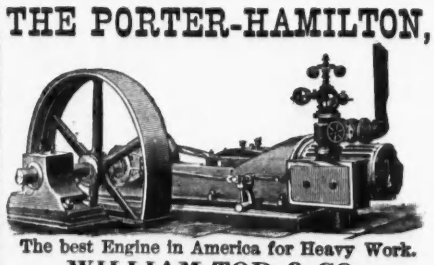

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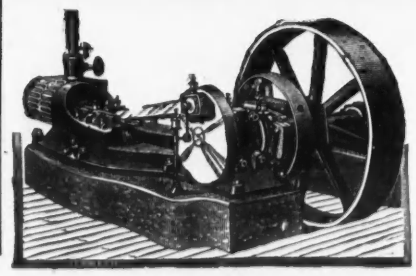

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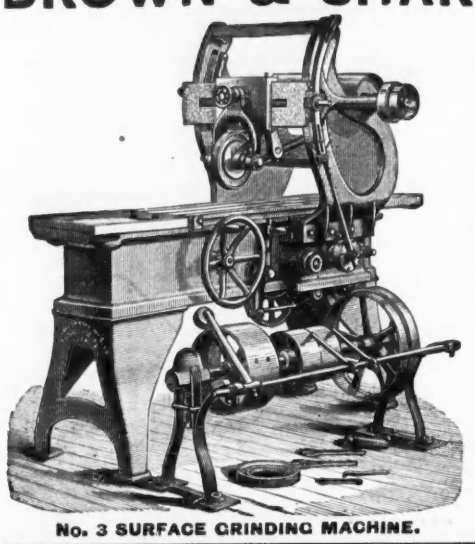

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With 6 in. x 10 in. stroke.

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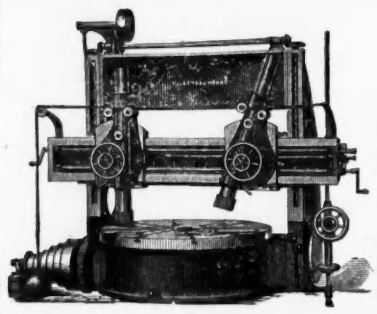

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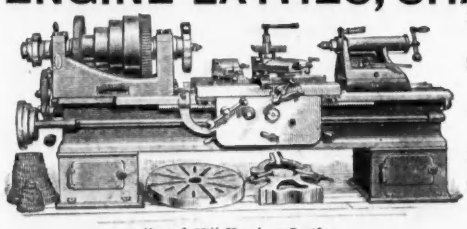

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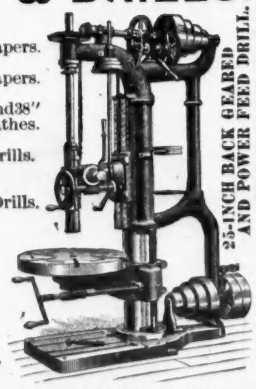

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These machines are in first-class order, and will be sold cheap if disposed of soon.

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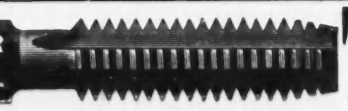

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